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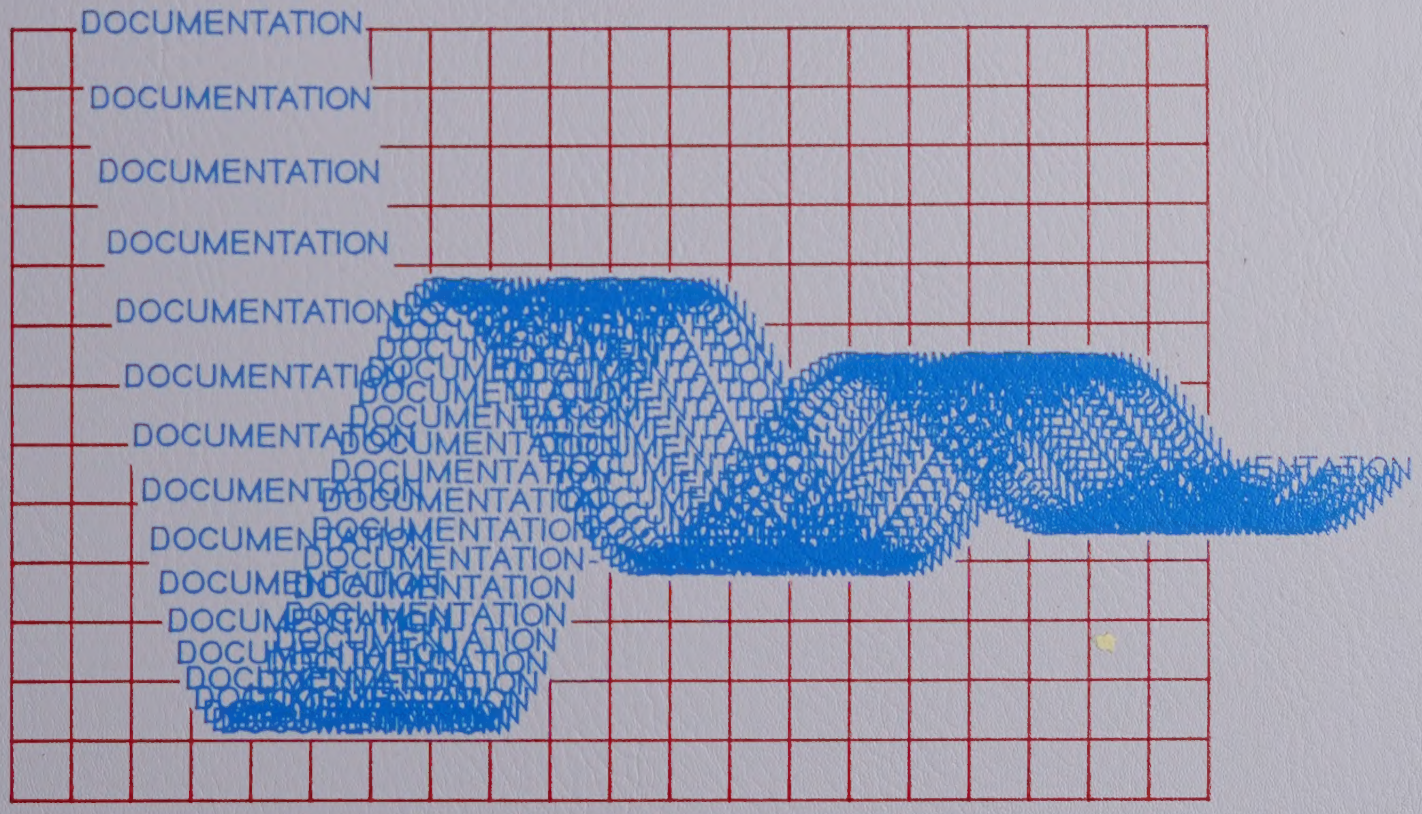

ROHDE&SCHWARZ

Test and Measurement
Division

Operating Manual

SPECTRUM ANALYZER

FSEA20/30
1065.6000.20/30

FSEB20/30
1066.3010.20/30

FSEM20/30
1080.1505.20/1079.8500.30

FSEK20/30
1088.1491.20/1088.3494.30

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Certificate of quality
EC Certificate of Conformity
List of R & S Representatives

Supplement

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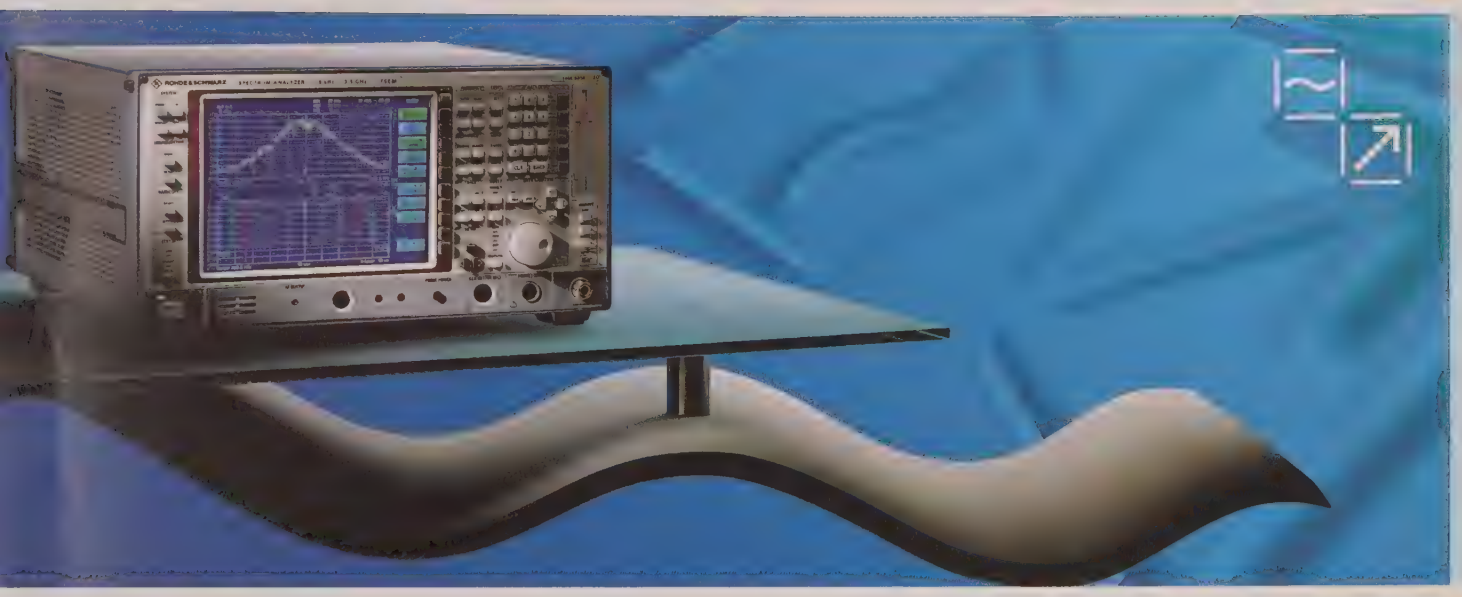


The spectrum analyzers from Rohde&Schwarz

Overview

The FSE spectrum analyzers from Rohde&Schwarz have been optimized both for general-purpose measurements and meeting the stringent requirements of testing advanced digital communication systems. Extremely high measurement speed, future-proof modular design and excellent characteristics put the analyzers right at the top of today's market – at a price of a medium-range product.

Characteristics

- Combines the following functions: spectrum analysis *and* analysis of digitally modulated signals (option)
- Fastest synthesizer worldwide incorporated in a spectrum analyzer
- Adaptation of all models to your specific requirements by means of a wide range of options.
  Easy upgrading of basic models into top-class models

Spectrum Analyzers FSE

20 Hz to 40 GHz

- Spectrum analysis
  with ultra-wide dynamic range
  Noise figure = 15 dB/T.O.I. = 15 dBm
  and
- Universal analysis of digital and analog modulated signals (option)
  BPSK, QPSK, π/4-DQPSK, QAM
  MSK, GMSK, AM, FM, PM

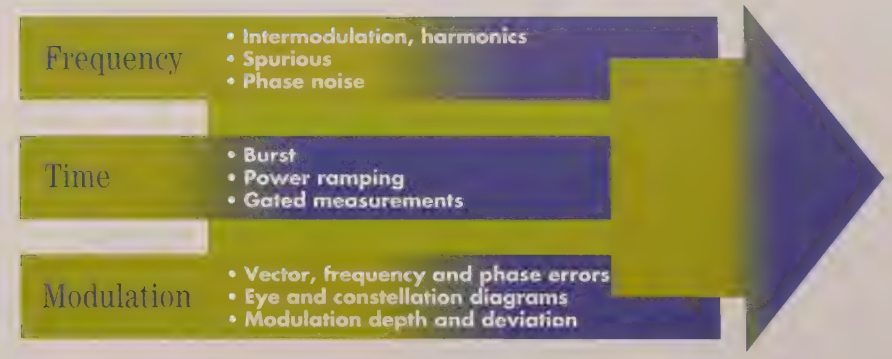
- High-speed synthesizer
  5 ms for full span (FSEA, FSEB)

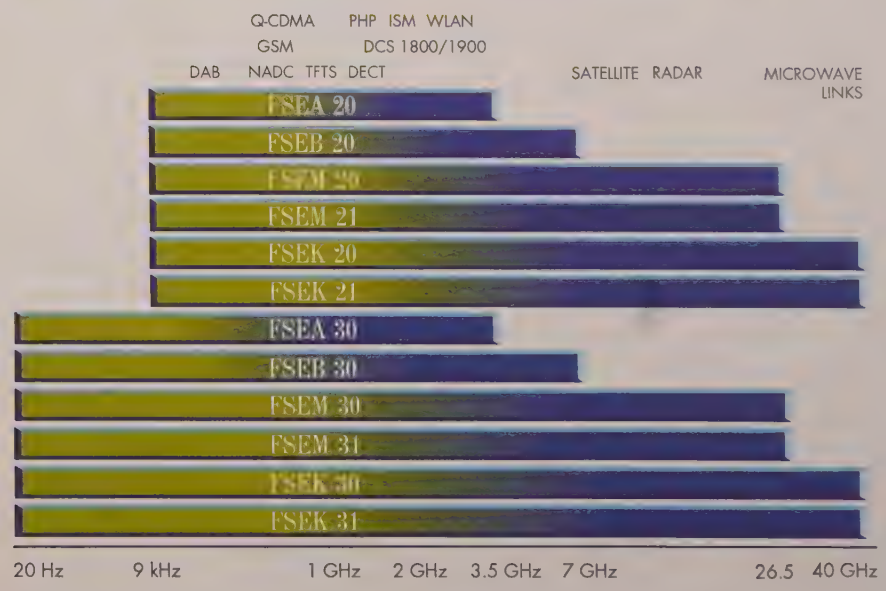
- Refresh rate, quasi-analog
  25 sweeps/s

- Large LC TFT display
  24 cm/9.5", active

- Future-proof modular design
  Customized solutions through wide variety of options

ROHDE&SCHWARZ





Modular design for a safe investment

The FSE "option building blocks"

Option/function/software	Designation	FSEA		FSEB		FSEM				FSEK			
		20	30	20	30	20	21	30	31	20	21	30	31
Frequency from 20 Hz	–	–	●	–	●	–	–	●	●	–	–	●	●
Frequency to 3.5 GHz	–	●	●	–	–	–	–	–	–	–	–	–	–
7-GHz Frequency Extension	FSE-B2	○	○	●	●	–	–	–	–	–	–	–	–
TV Demodulator	FSE-B3 [1]	○	○	○	○	○	○	○	○	○	○	○	○
Low Phase Noise and OCXO	FSE-B4	○	●	○	●	○	○	●	●	○	○	●	●
FFT Filter	FSE-B5	○	●	○	●	○	○	●	●	○	○	●	●
Vector Signal Analyzer	FSE-B7	○	○	○	○	○	○	○	○	○	○	○	○
Tracking Generator 3.5 GHz	FSE-B8	○	○	–	–	–	–	–	–	–	–	–	–
Tracking Generator 3.5 GHz with I/Q Modulator	FSE-B9	○	○	–	–	–	–	–	–	–	–	–	–
Tracking Generator 7 GHz	FSE-B10	–	–	○	○	–	–	○	○	–	–	○	○
Tracking Generator 7 GHz with I/Q Modulator	FSE-B11	–	–	○	○	–	–	○	○	–	–	○	○
Switchable Attenuator for Tracking Generator	FSE-B12	○	○	○	○	○	○	○	○	○	○	○	○
Controller	FSE-B15	○	○	○	○	○	○	○	○	○	○	○	○
Ethernet Interface	FSE-B16	○	○	○	○	○	○	○	○	○	○	○	○
2nd IEC/IEEE-Bus Interface	FSE-B17	○	○	○	○	○	○	○	○	○	○	○	○
Removable Harddisk	FSE-B18 [1]	○	○	○	○	○	○	○	○	○	○	○	○
Second Harddisk for FSE-B18	FSE-B19	○	○	○	○	○	○	○	○	○	○	○	○
External Mixing	FSE-B21	–	–	–	–	○	●	○	●	○	●	○	●
Increased Level Accuracy up to 2 GHz	FSE-B22 [1]	○	○	○	○	○	○	○	○	○	○	○	○
Broadband Output 741.4 MHz	FSE-B23 [1]	○	○	○	○	○	○	○	○	○	○	○	○
Noise Measurement Software	FSE-K3	○	○	○	○	○	○	○	○	○	○	○	○
GSM Application Firmware	FSE-K10/ -K11	○	○	○	○	○	○	○	○	○	○	○	○

● Incorporated in basic model ○ Can be retrofitted (option) [1]) Factory-fitted only.

FSE options and their applications

Digital mobile radio systems	Analog mobile radio systems	TV and CATV	AM and FM sound broadcasting	General-purpose RF measurements		
○			○		FSE-B2	7-GHz Frequency Extension
		●			FSE-B3	TV Demodulator
○	●		●		FSE-B4	Low Phase Noise and OCXO
●	○	●			FSE-B7	Vector Signal Analyzer
		○	○		FSE-B8/-B9/ -B10/-B11	Tracking Generator
○			○		FSE-B15	Controller
			○		FSE-B21	External Mixing
			○		FSE-B23	Broadband Output 741.4 MHz
○	○		○		FSE-K3	Noise Measurement Software
○					FSE-K10/-K11	GSM Application Firmware

● Required ○ Recommended

Getting down to analysis

Specifications in brief

- Resolution bandwidths 10 Hz to 10 MHz (models .20/.21), 1 Hz to 10 MHz (models .30/.31), adjustable in steps of 1/2/3/5/10
- Displayed noise floor –150 dBm (typ.) in 10-Hz bandwidth
- 3rd-order intercept point +15 dBm
- 1-dB compression point of RF input >+10 dBm
- Phase noise at 10 kHz from carrier: –123 dBc/Hz (FSEA 30)
- Total measurement error up to 1 GHz <1 dB, up to 7 GHz 1.5 dB
- AM/FM demodulator (with built-in loudspeaker and headphones connector)

Internal RF trigger (trigger threshold approx. –20 dBm)

- 5 ms full-span sweep time with fully synchronized sweep (FSEA, FSEB), 150 ms with FSEM
- 1 µs zero-span sweep time
- Pretrigger and trigger delay
- Gated sweep

Vector analysis for digital communication

The analyzers of the FSE family combine the capabilities of high-end RF or microwave spectrum analysis with those of universal digital-signal demodulation and analysis. This becomes possible with the vector signal analyzer option. The spectrum analyzer function offers the wide dynamic range necessary for many measurements on digitally modulated signals (eg burst measurements), and the vector signal analyzer option adds demodulation capability to bit stream level for

– BPSK – QPSK
– π/4-DQPSK – 16QAM
– (G)MSK – (G)FSK

All this is backed up by a variety of display types:

- Eye diagrams
- Vector and constellation diagrams
- Frequency and phase error
- Vector error

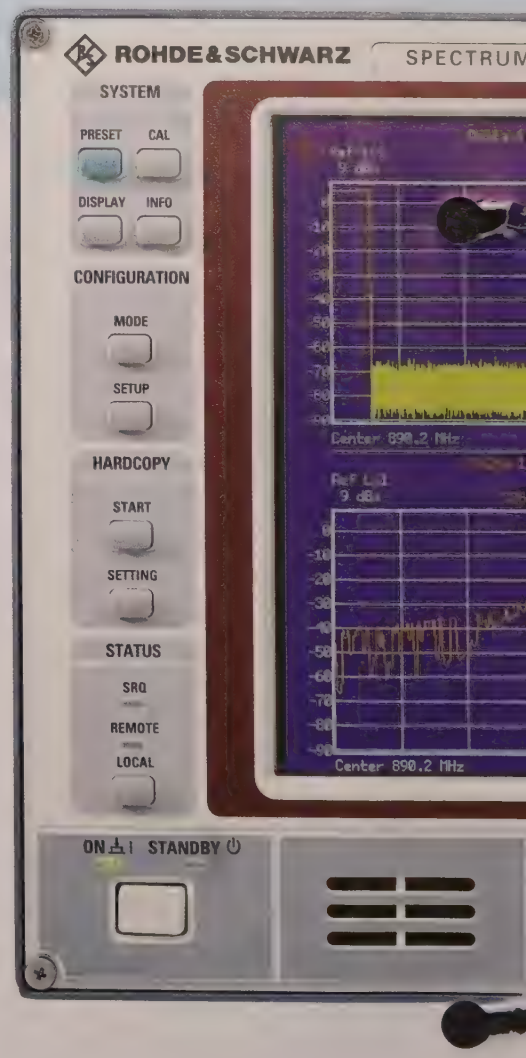
With a spectrum analyzer of the FSE family, you are perfectly equipped for the future of digital communication.

Modularity safeguards investments

Series FSE analyzers are of modular design throughout. From the wide variety of options, you can choose exactly those needed for your particular application (see table on folding page).

You thus get an instrument tailor-made to your requirements and pay for no more than what you actually need. At the same time, you can feel sure that FSE will grow with your tasks and requirements as virtually all options can be retrofitted and model .20/.21 units can easily be upgraded later to almost the same performance as provided by top-class models .30/.31. Even extending the frequency range from 3.5 GHz to 7 GHz is no problem with option FSE-B2.

Your decision for Spectrum Analyzer FSE is a decision for a safe investment.

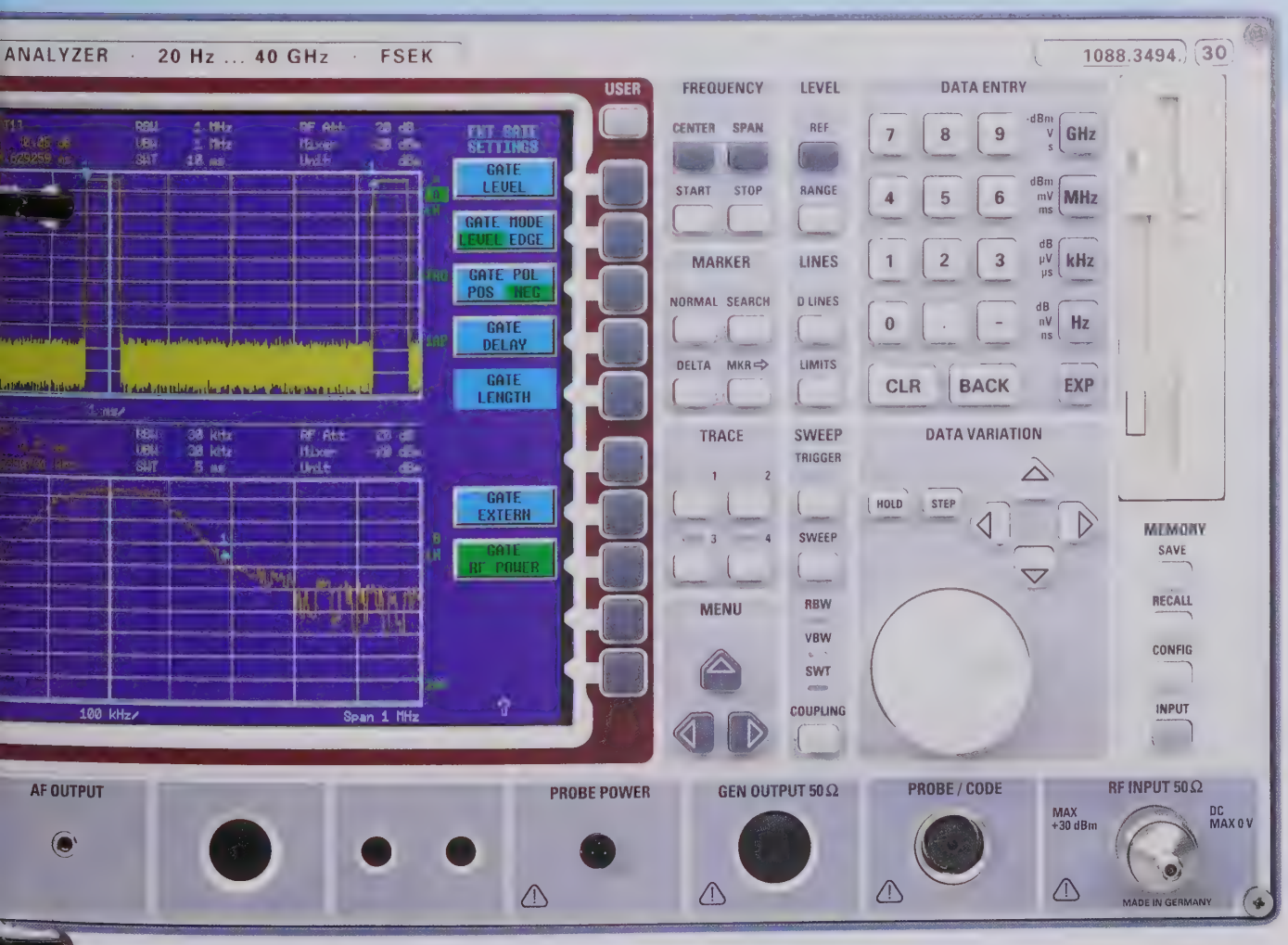


A triple record holder in speed

FSE breaks the speed record in three fields:

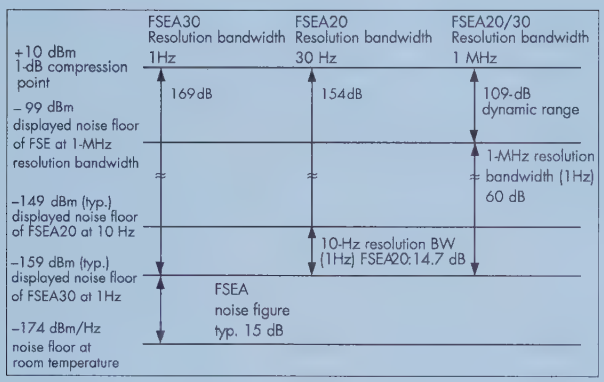
- FSE features a minimum full-span sweep time of 5 ms (for FSEA and FSEB) with a fully synchronized sweep. This means that added speed is not at the expense of frequency accuracy but even enhances it.
- The shortest zero-span sweep time is 1 µs (100 ns/div) – ideal for high-resolution measurements on pulse edges.
- Up to 25 sweeps per second is an optimal prerequisite for rapid and easy alignments and for applications in production.

With its high measurement speed and great ease of operation, FSE will solve even highly complex measurement tasks in the shortest possible time.

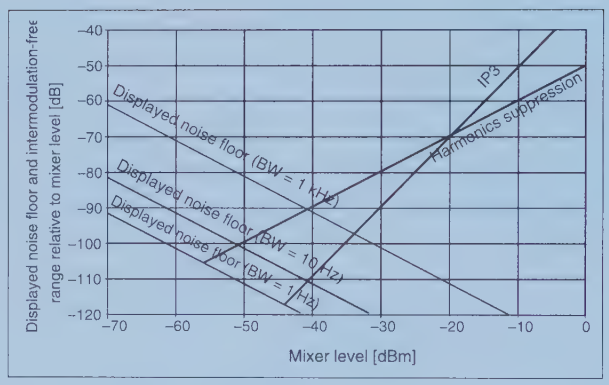


Spectrum Analyzer
FSEK30

The features in detail



Dynamic range, noise and 1-dB compression point for models of Spectrum Analyzer FSE



Dynamic range, noise, 3rd-order intercept point

Tops in dynamic range

FSE is outstanding for its extremely low noise floor without any impairment to the dynamic range at large signal levels. This can be seen, for example, from the 1-dB compression point of +10 dBm, which yields a dynamic range of 109 dB even at a resolution bandwidth of 1 MHz, allowing GSM and DECT power ramps to be determined.

The extremely wide intermodulation-free dynamic range of typ. 116 dB (models .30/.31) and 105 dB (models .20/.21) not only ensures reliable measurements on highly linear amplifiers, it also enables detailed analysis of complex broadband signals.

Taking as a figure of merit of an analyzer the difference between its 3rd-order intercept point and its noise figure, FSEA can offer a value of around 0 dB. Put this figure to the test.

From AF to microwave

FSEM/K20/.30 open up the microwave range through to 26.5/40 GHz and retain the excellent characteristics of the 3.5 and 7 GHz basic models:

- Continuous full-span sweep
- Fundamental mixing, low noise floor as well as wide dynamic range up to 26.5 GHz
- Fully synchronized sweep with high frequency accuracy even for FULL SPAN (26.5/40 GHz)
- RF input adapters for N or PC 3.5-mm, or with FSEK K male/female connector

FSEM31/FSEK31 (corresponding to FSEM/K20/.30 with option FSE-B21) allow frequency range extension by means of external mixers. Continuous automatic signal identification, which is used to suppress unwanted image frequency bands and mixture products, ensures fast and easy measurements. Due to the built-in diplexer, three-port as well as two-port mixers can be used.

The external mixer measurement function features great ease of operation:

- Definition of frequency range and harmonics by selection of a waveguide band
- Definition of all important parameters for each waveguide band separately
- Frequency-dependent consideration of mixer conversion loss
- Storage of parameters on hard disk

Unattained measuring convenience

FSE makes measuring easy for you, offering a large number of convenient test functions:

- 4 markers, 4 delta markers
- Marker functions for direct measurement of
  - phase noise and noise power density (/Hz)
  - NEXT MIN/PEAK, NEXT MIN/PEAK RIGHT, NEXT MIN/PEAK LEFT

Model	Frequency range	On-Screen Dynamic Range	Resolution bandwidths	Low phase noise and OCXO	1-Hz resolution bandwidth	FFT Filter
FSEA20	9 kHz to 3.5 GHz	95 dB	10 Hz to 10 MHz, 4-pole filters	❍	❍	❍
FSEA30	20 Hz to 3.5 GHz	105 dB	1 Hz to 10 MHz, 5-pole filters	●	●	●
FSEB20	9 kHz to 7 GHz	95 dB	10 Hz to 10 MHz, 4-pole filters	❍	❍	❍
FSEB30	20 Hz to 7 GHz	105 dB	1 Hz to 10 MHz, 5-pole filters	●	●	●
FSEM20	9 kHz to 26.5 GHz	95 dB	10 Hz to 10 MHz, 4-pole filters	❍	❍	❍
FSEM21	9 kHz to 26.5 GHz[1])	95 dB	10 Hz to 10 MHz, 4-pole filters	❍	❍	❍
FSEM30	20 Hz to 26.5 GHz	105 dB	1 Hz to 10 MHz, 5-pole filters	●	●	●
FSEM31	20 Hz to 26.5 GHz[1])	105 dB	1 Hz to 10 MHz, 5-pole filters	●	●	●
FSEK20	9 kHz to 40 GHz	95 dB	10 Hz to 10 MHz, 4-pole filters	❍	❍	❍
FSEK21	9 kHz to 40 GHz[1])	95 dB	10 Hz to 10 MHz, 4-pole filters	❍	❍	❍
FSEK30	20 Hz to 40 GHz	105 dB	1 Hz to 10 MHz, 5-pole filters	●	●	●
FSEK31	20 Hz to 40 GHz[1])	105 dB	1 Hz to 10 MHz, 5-pole filters	●	●	●

Differences between FSE models in detail: ● Incorporated in basic model ❍ Can be retrofitted [1]) Can be extended with external mixer.

– bandwidths and shape factor
- Measurement of channel power, adjacent channel power and occupied bandwidth
- Frequency counter with selectable resolution
- LOW NOISE, NORMAL and LOW DISTORTION modes to cater for low-intermodulation and low-noise operation
- One-button hardcopy on printer or plotter
- Simultaneous measurement of four active traces
- Level, frequency and user-definable limit lines as evaluation help with pass/fail information
- Split screen with independent measurement windows
- Quasi-analog display

Frequency accuracy to the point

Tuning on FSE is absolutely synchronous to the reference frequency for each span including full span. This means that every point on the frequency axis is determined with the accuracy of the internal reference frequency and the pixel resolution. Thus, when reducing the span for detailed signal analysis, the tiresome readjustment of the center frequency is no longer needed.

FSE in its basic configuration includes an AM/FM audio demodulator. Unknown signals can thus easily be identified via headphones or the built-in loudspeaker. Modulation measurements are possible using the optional Vector Signal Analyzer FSE-B7.

Limit lines facilitate checking if results are within predefined tolerances. Virtually any number of limit lines can be defined with high accuracy by means of 50 points to meet even the most exacting requirements.

Tracking generators

The optional tracking generators (see data sheet for FSE-B8/9/10/11) are an ideal tool for determining frequency response, attenuation or VSWR and feature the following characteristics:
- Wide dynamic range for attenuation measurements (up to 120 dB)
- Frequency range from 9 kHz to 3.5/7 GHz
- Frequency offset up to ± 200 MHz for measurements on frequency-converting modules

To generate digitally modulated signals the tracking generators with built-in I/Q modulator are ideal. An external two-channel Arbitrary Waveform Generator (eg ADS from Rohde & Schwarz) serves as modulation source.

By adding the optional Vector Signal Analyzer FSE-B7, FSE can be expanded to a test assembly enabling direct measurement of the influence of amplifiers or filters on phase error for instance.

The features in detail

Designation	Type	Use	Functions
Noise Measurement Software	FSE-K3	Noise figure measurements	• Measurement of noise figure and temperature to Y-factor method • Conversion measurements (down conversion) • Frequency range same as basic unit, starting from 100 kHz • Editor for ENR tables • Runs under Windows® 3.1 on the internal controller (option) or on an external PC
Application Firmware [1]	FSE-K10, Mobile FSE-K11, BTS	Mobile radio, transmitter measurements to GSM standards 11.10 and 11.20	• Power ramp and power template • Spectrum due to modulation/switching • Spurious emissions • Mean carrier power • Phase/frequency error (with option FSE-B7)

[1] See data sheet FSE-K10/-K11.

Operation – as you like it

Despite their comprehensive functionalities the analyzers feature great ease of operation. Basic functions and frequently used help tools such as markers can be called at a keystroke. The full operating convenience based on a wide variety of evaluation routines and marker functions can be accessed via the menus.

All essential parameters and results can be seen at a glance. All test data, scale factors and setting parameters are logically arranged and thus easy to find. Setups, traces and graticules displayed in colour make for error-free analysis of complex results.

All models are equipped with a large 24-cm (9.5") TFT colour display with VGA resolution (640 x 480 pixels).

The USER key allows FSE operation to be tailored to your specific requirements. With this key, you can compile the functions mainly needed for your measurement tasks, doing away with frequent menu changes and speeding up measurements on the whole.

Test results – perfectly documented

FSE affords uncomplicated logging of results. It supports a wide variety of printers or plotters:

- FX-80 and compatibles
- Printers with HP-PCL
- HP-GL
- Postscript

Print files can not only be output via an interface but also be stored on diskette or the internal harddisk. With PCX, WMF and HP-GL print formats being available, there is no problem in further processing print files in standard text processing systems. Using Controller FSE-B15, it is particularly easy to generate test reports and integrate the results. Texts can then be processed under Windows® on FSE itself.

FSE works as a Controller

The optional Controller FSE-B15 provides a further VGA card, a memory extension to 16 Mbyte, a serial mouse and a keyboard. FSE-B15 is available in English and German and is supplied installed in FSE when ordered together with the unit. The option opens up the world of Windows®-3.1 applications (standard mode), eg statistics programs or spreadsheet analysis. FSE can even be linked to a network using the optional Ethernet Interface FSE-B16.

Complete setups, traces, limit lines and macros can be stored non-volatile on the internal harddisk or on diskette with the built-in 1.44-Mbyte drive.

Rear of Spectrum Analyzer FSE

Quality management at Rohde&Schwarz

Lasting customer satisfaction is our primary objective. The quality management system of Rohde&Schwarz meets the requirements of ISO 9001 and encompasses largely all fields of activity of the company.

Certified Quality System
ISO 9001

FSE in automatic test systems

FSE is ideal for use in automatic test systems, affording not only fast processing of results but also an IEC/IEEE-bus command set conforming to SCPI.

Moreover, with optional Controller FSE-B15 and a second IEC/IEEE-bus card (option FSE-B17), FSE can be used as a controller for test systems, thus eliminating the need for further units and saving space in the system cabinet.

Low overall costs

In designing FSE, special emphasis was placed on keeping after-sales costs to a minimum:

- Temperature-controlled blowers
- Calibration interval up to 2 years
- Built-in calibration routines
- Numerous selftest routines
- Modular design

Calibration routines

Built-in calibration routines ensure that FSE remains within defined tolerances and thus maintains its accuracy of measurement. The routines are not performed automatically by the instrument but can be started by the user, thus avoiding ongoing measurements to be interrupted.

The results of calibration routines are output by FSE in the form of comprehensive correction tables. Comparing these tables over an extended period of time, the user can detect changes early and take corrective steps in time. This enhances confidence in the unit's reliability and measurement accuracy.

A particular asset in system applications is the internally selectable, high-precision level calibration source, which reduces the number of cables required.

Selftest the built-in diagnostic system

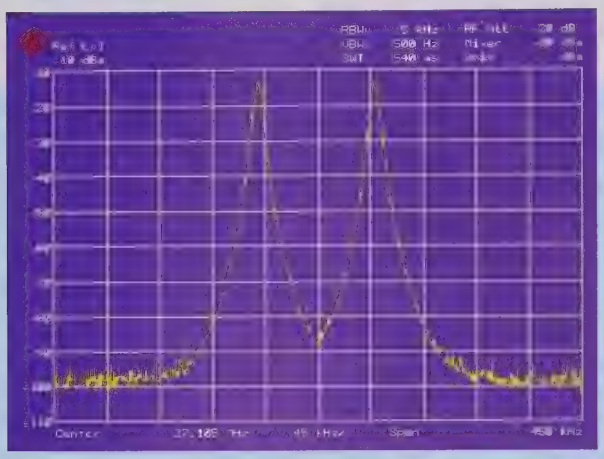
The instrument selftest rapidly locates any faults down to module level. Defective modules can be replaced nearly without adjustments or extra test equipment being required. This in conjunction with the quick spare parts service from Rohde&Schwarz reduces any repair or down-time costs that might arise. The low operating costs go easy on your budget.

Modular design – easy retrofitting of options

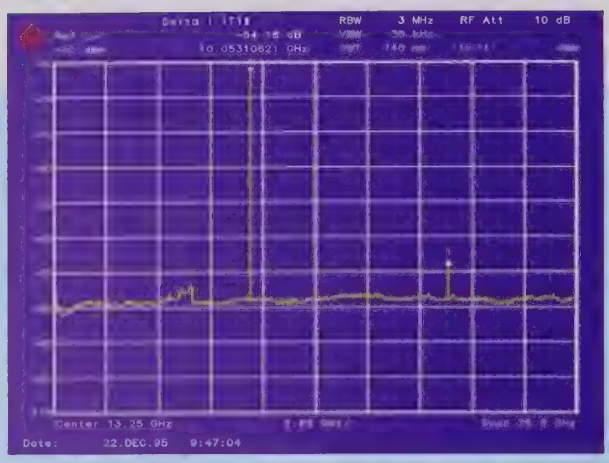
The easy concept for fitting the most important options, ie Vector Signal Analyzer, Low Phase Noise and OCXO, 7-GHz Frequency Extension, as well as the easy, adjustment-free incorporation of the remaining options make it possible to retrofit the instrument with a minimum of downtime or installation costs being involved.

Applications

General-purpose RF measurements



1



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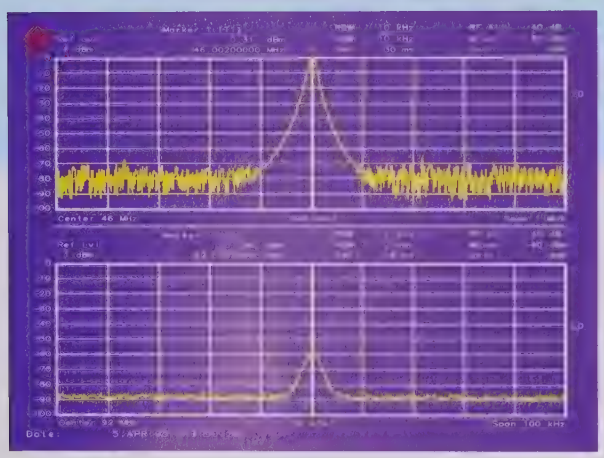

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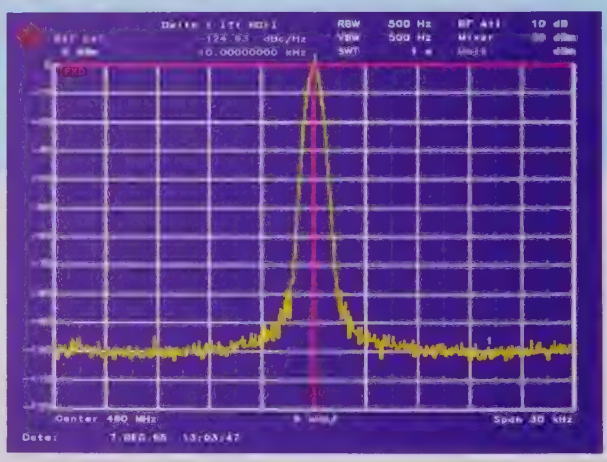


4

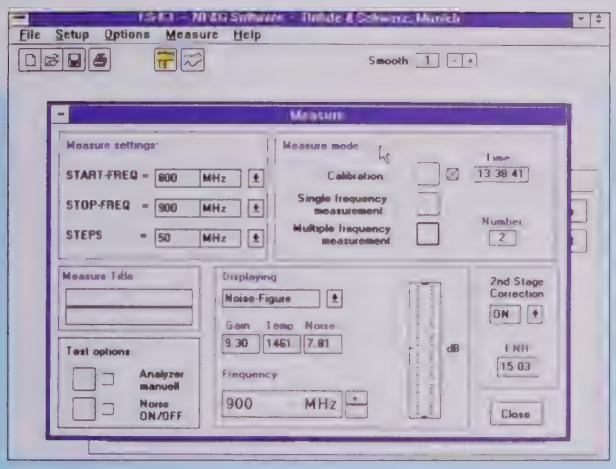
Two-tone measurements (1)
FSE facilitates intermodulation measurements with its wide intermodulation-free dynamic range, which reduces measurement errors. This feature is enhanced by the LOW DISTORTION mode, which ensures optimum RF attenuation. Evaluation of results is rapid and easy by means of markers and delta markers.

Harmonics measurements with split screen (2)
The split-screen function has been provided for the convenient analysis of results. In harmonics measurements, for example, the fundamental and the first harmonic can be displayed simultaneously with high resolution.

Low noise floor even in the microwave range (3)
Thanks to fundamental mixing FSEM features the same constantly low noise floor as an RF analyzer up to 26.5 GHz. As a consequence, FSEM offers not only a wide dynamic range, but also a considerably increased speed for measuring small signals in the microwave range: Larger resolution bandwidths and high sensitivity reduce sweep time while maintaining the S/N ratio. This is of great advantage when measuring spurious and harmonics alike.

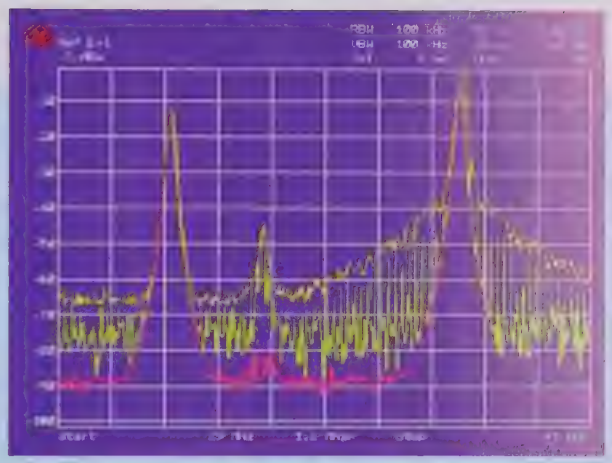
FSE phase noise as a function of carrier spacing (4)
With a phase noise of –123 dBc/Hz at 10 kHz from the carrier, the synthesizer incorporated in FSEA 30 is ideal for measuring the phase noise of oscillators or the adjacent-channel power of radio equipment. FSEA 20, on the other hand, is ideal for applications where phase noise in the vicinity of the carrier plays a less important role. Thanks to the modular design of the instrument, FSEA 20, FSEB 20, FSEM 20/.21 and FSEK 20/.21 can easily be retrofitted with the synthesizers of models .30/.31.

Noise figure measurements



1

TV measurements



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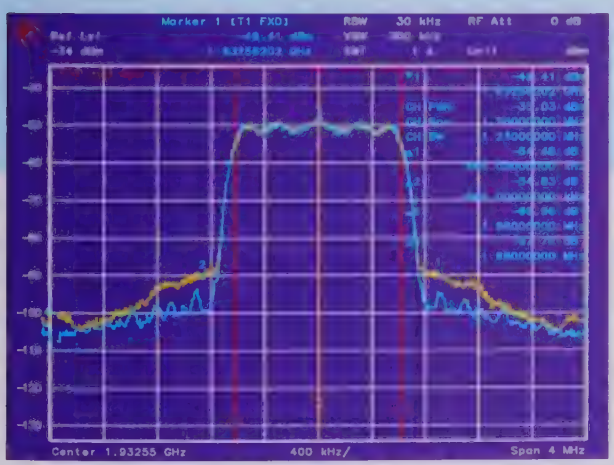

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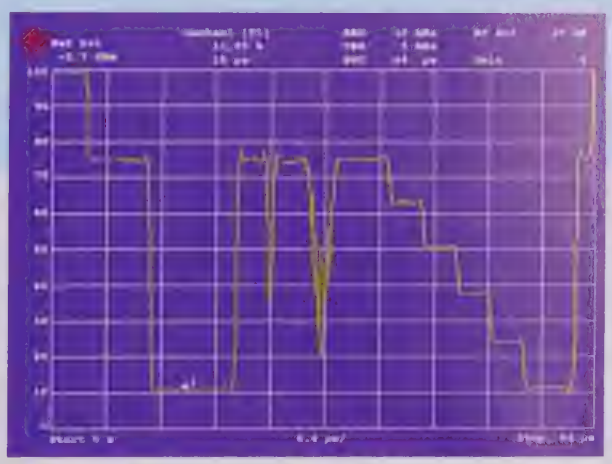


4

Noise Measurement Software FSE-K3 (1)

FSE-K3 turns your FSE into a noise measurement system offering the advantages of an analyzer (see also data sheet 757.2380):

- From the large number of resolution bandwidths available, you can choose the right one for your application, even for measurements on narrowband DUTs
- With ambiguous results, you can check your test system for EM pick-up or nonharmonics
- The lower frequency limit is 100 kHz
- Measurements on frequency-converting DUTs are supported with the use of an external generator

RMS detector: power measurement without correction factors as shown in **FIG 2** where the power of a CDMA signal in the transmission and the adjacent channels is measured. The two traces show the influence of the DUT on the adjacent-channel power. Measuring power and adjacent-channel power of digitally modulated signals requires a spectrum analyzer to be equipped with special detectors and test routines. FSE is the first and the only spectrum analyzer that features a real power detector with wide dynamic range – the RMS detector. Like a thermocouple power meter, this detector guarantees stable and accurate test results without any correction factors. Considerably higher test throughput is achieved than with the usual sample detector. Using the available default settings for ACP measurements in line with common standards (NADC, PDC, CDMA, etc) precise test results are obtained easily and fast.

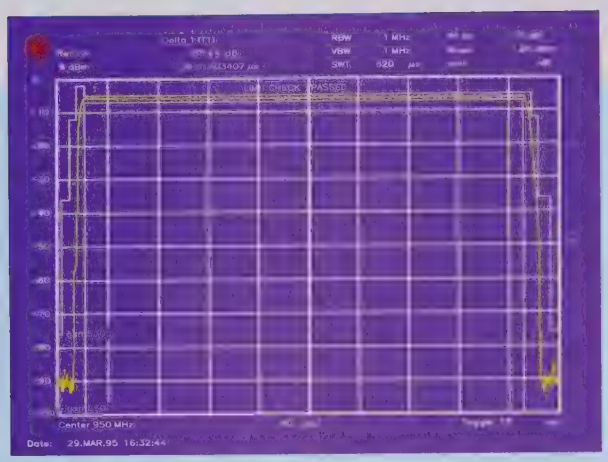
TV signal in zero span and TV trigger (3 and 4)

With a maximum resolution bandwidth of 10 MHz, implemented with the optional TV Demodulator FSE-B3, and the high resolution of 100 ns/div, FSE meets all requirements for the analysis of TV signals. In addition, FSE-B3 provides the following functions:

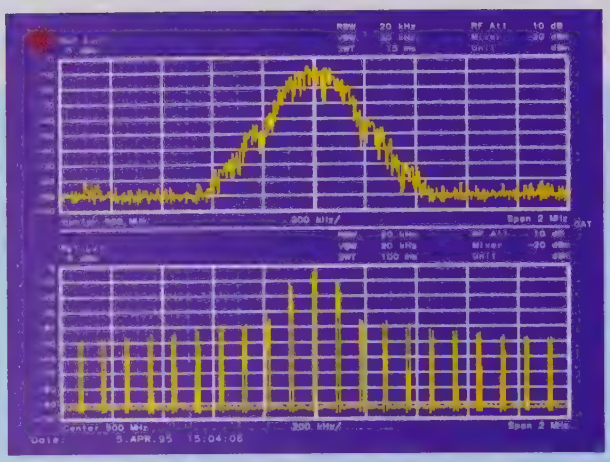
- Frame trigger
- Line trigger with selection of line

Applications

Mobile radio – digital and analog



1



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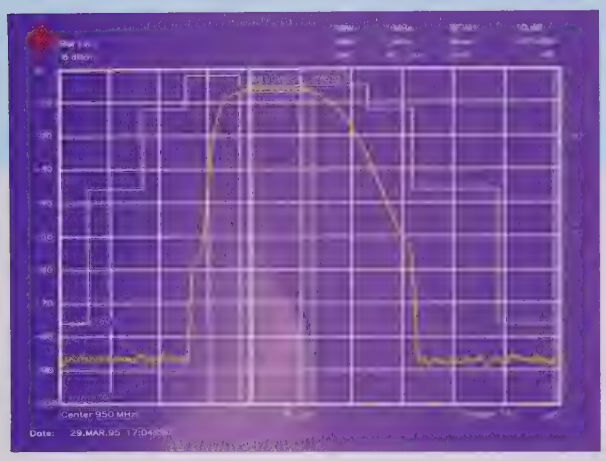

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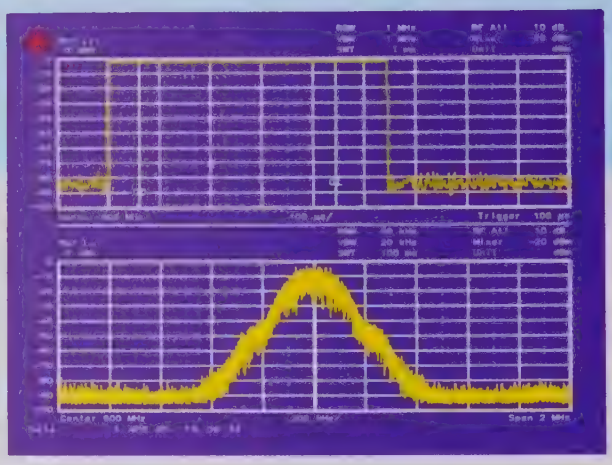


4

- CCVS output for connecting a monitor, adaptable to all standards

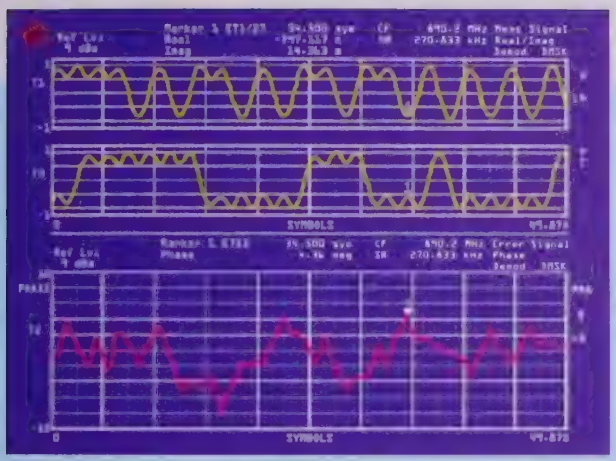
Moreover, the quasi-analog display provides luminance-signal information, enabling the detection of intermodulation products in the TV spectrum.

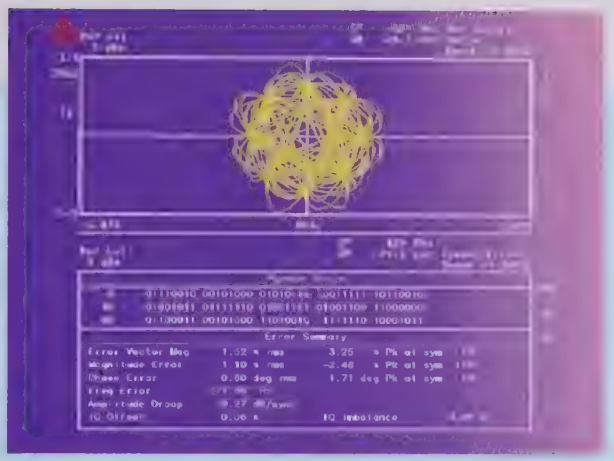
RF power trigger replaces external trigger (no illustration)
An internal broadband level detector (center frequency ±50 MHz) with a fixed switching threshold of approx. –20 dBm at the first mixer is used as a trigger source. With this detector it is possible, for example, to perform "Spectrum due to switching" and "Spectrum due to modulation" measurements to GSM specifications without an external trigger. Likewise, the detector replaces the external trigger needed in the gated sweep mode.

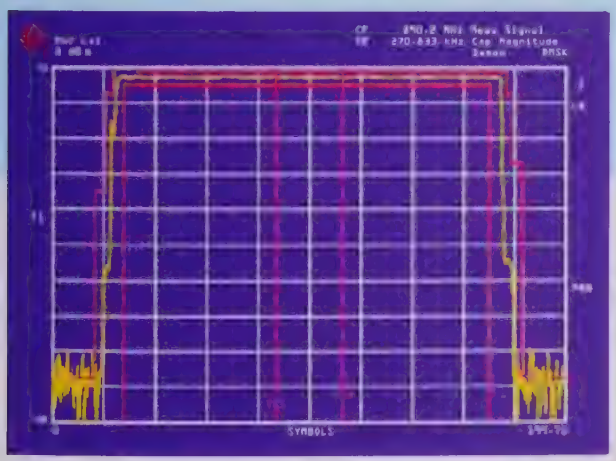
Gap sweep: simultaneous measurement of pulse rise and fall times with high time resolution (1 and 2)
The fast sweep time of 100 ns/div as well as the gap sweep and pretrigger functions of Spectrum Analyzer FSE make it possible to measure the rise and fall times of an RF pulse simultaneously and with high time resolution. The center of the pulse, which is of no interest, is blanked. Even at a resolution bandwidth of 1 MHz FSE offers a dynamic range of over 80 dB thanks to the high 1-dB compression point of +10 dBm.

Gated sweep (3 and 4)
The gated sweep function is indispensable for analyzing TDMA signals used in modern communication systems. With this function, the spectrum of burst signals can be investigated without any interference being caused by switching the signals on and off. The selected gate time determines over what interval a pulse is to be analyzed. Selection of the gate time is very easy and convenient in the time domain display (zero span) of the pulse.

Vector signal analysis







1 I/Q signal and phase error measurements over 50 symbols of a GSM mobile

2 Measurement of GSM power ramps to standards with high-precision time reference through synchronization to mid-amble

3 Measurement of modulation error of π/4-DQPSK signals (NADC)

Universal analysis of digital signals

Spectrum Analyzer FSE in conjunction with the optional Vector Signal Analyzer FSE-B7 is ideal for demodulating and measuring digitally modulated signals with frequencies up to 3.5 GHz, 7 GHz, 26.5 GHz or 40 GHz. This universal tool offers a wide variety of settings:

- Demodulation of all common mobile-radio signals
- Freely selectable symbol rates
- Type of filter
- Roll-off factor or BT product of filter
- Synchronization bit sequences
- Predefined, application-specific settings for all common standards, eg GSM, PCS 1900, NADC, CDMA (IS95)

Versatile display of results

- In-phase and quadrature signals
- Magnitude and phase
- Vector and constellation diagrams
- Eye and trellis diagrams
- Sum fault: amplitude, frequency, phase, vector

Power ramp measurements

To perform power ramp measurements on TDMA systems such as GSM or DECT in line with standards, reference must be made to synchronization sequences (pre- or mid-amble) in order to establish a time reference. Making such measurements to standard is not possible using conventional analyzers – it is no problem with FSE!

Accurate AM, FM and φM measurements

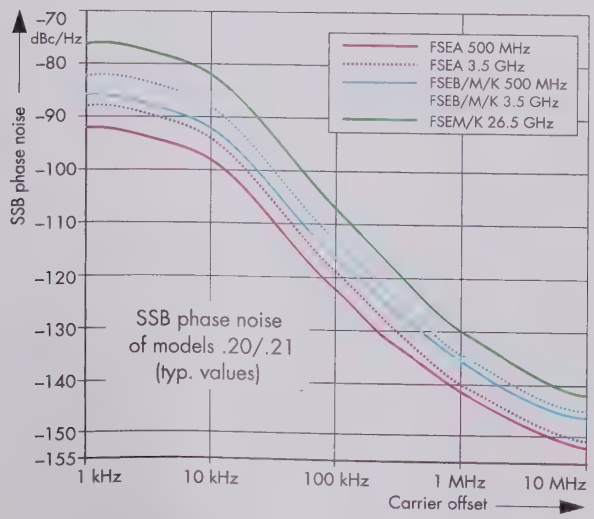
Featuring high-accuracy measurement of the modulation depth and frequency deviation coupled with the display of demodulated signals in the time domain, FSE not only enables testing of analog and dual-mode radio equipment but also the determination of fast transient response in frequency and amplitude (see separate data sheet Vector Signal Analyzer FSE-B7, order number 757.2167).

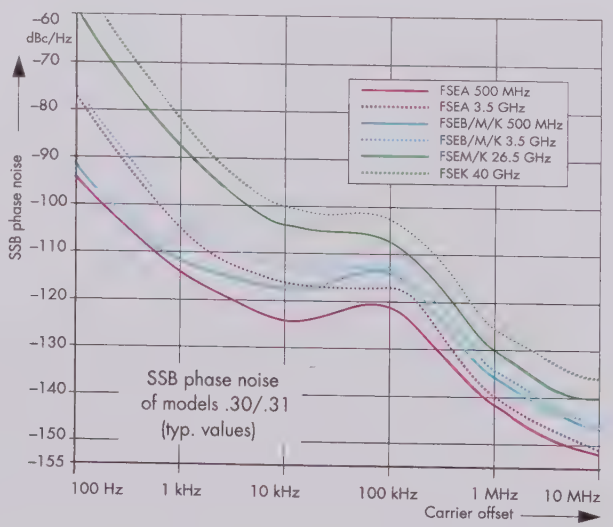
Spectrum Analyzer FSE and the optional vector signal analyzer provide universal test capabilities in one unit.

Specifications

	FSEA20	FSEA30	FSEB20	FSEB30	FSEM20/.21	FSEM30/.31	FSEK20/.21	FSEK30/.31
Specifications are guaranteed under the following conditions: 30 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to, and total calibration performed. Data without tolerances: typical values only. Data designated "nominal" apply to design parameters and are not tested.								
Frequency								
Frequency range (models .21/.31: can be extended by ext. mixing)	9 kHz to 3.5 GHz	20 Hz to 3.5 GHz	9 kHz to 7 GHz	20 Hz to 7 GHz	9 kHz to 26.5 GHz	20 Hz to 26.5 GHz	9 kHz to 40 GHz	20 Hz to 40 GHz
Frequency resolution	0.01 Hz							
Refer. frequency Internal, nominal								
Aging per day[1]	–	1×10^{-9}	–	1×10^{-9}	–	1×10^{-9}	–	1×10^{-9}
Aging per year[1]	1×10^{-6}	2×10^{-7}	1×10^{-6}	2×10^{-7}	1×10^{-6}	2×10^{-7}	1×10^{-6}	2×10^{-7}
Temperature drift (0°C to 50°C)	1×10^{-6}	5×10^{-8}	1×10^{-6}	5×10^{-8}	1×10^{-6}	5×10^{-8}	1×10^{-6}	5×10^{-8}
Total error (per year)	2.5×10^{-6}	2.5×10^{-7}	2.5×10^{-6}	2.5×10^{-7}	2.5×10^{-6}	2.5×10^{-7}	2.5×10^{-6}	2.5×10^{-7}
With option FSE-B4								
Aging per day[1]	1×10^{-9}	–	1×10^{-9}	–	1×10^{-9}	–	1×10^{-9}	–
Aging per year[1]	2×10^{-7}	–	2×10^{-7}	–	2×10^{-7}	–	2×10^{-7}	–
Temperature drift (0°C to 50°C)	5×10^{-8}	–	5×10^{-8}	–	5×10^{-8}	–	5×10^{-8}	–
Total error (per year)	2.5×10^{-7}	–	2.5×10^{-7}	–	2.5×10^{-7}	–	2.5×10^{-7}	–
External	10 MHz or n × 1 MHz, n=1 to 16							
Frequency display	with marker							
Resolution	0.1 Hz to 10 kHz (dependent on span)							
Error (sweep time >3× auto sweep time)	±(marker frequency × reference error + 0.5% × span + 10% × resolution bandwidth + 10 Hz + 1/2 (last digit))							
Frequency counter	measures the marker frequency							
Resolution	0.1 Hz to 10 kHz (selectable)							
Count accuracy (S/N >25 dB)	±(frequency × reference error + 10 Hz + 1/2 (last digit))							
Display range for frequency axis	0 Hz, 10 Hz to full span							
Resolution/error of display range	0.1 Hz/1%							
Spectral purity (dBc/Hz) SSB phase noise, f ≤500 MHz,	for f >500 MHz see diagrams below							
carrier offset 100 Hz[2]	–	<–87	–	<–81	–	<–81	–	<–81
1 kHz[2]	<–85	<–107	<–79	<–100	<–79	<–100	<–79	<–100
10 kHz[2]	<–95	<–120	<–90	<–114	<–90	<–114	<–90	<–114
100 kHz[3]	<–119	<–117	<–113	<–111	<–113	<–111	<–113	<–111
1 MHz[3]	<–135	<–135	<–129	<–129	<–129	<–129	<–129	<–129
With option FSE-B4	for models .20 with option FSE-B4 values of models .30 apply							
Sweep time								
Span = 0 Hz	1 µs to 2500 s in 5% steps							
Span ≥10 Hz	5 ms to 16000 s in steps ≤10%							
Error	1%							
Picture refresh rate (span ≤7 GHz)	>20 updates/s with 1 trace, >15 updates/s with 2 traces							
Sampling rate	50 ns (20-MHz A/D converter)							
Number of pixels	500							
Time measurement	with marker and cursor lines							
Resolution	50 ns							
Sweep trigger	free run, single, line, video, gated, delayed, external							
Zero span	additionally pretrigger, posttrigger, trigger delay							

[1]) After 30 days of operation. [2]) Models .20/.21: valid for span ≤50 kHz, RBW<1 kHz. [3]) Valid for span >100 kHz.





	FSEA20	FSEA30	FSEB20	FSEB30	FSEM20/.21	FSEM30/.31	FSEK20/	
Resolution bandwidths								
3-dB bandwidths (in 1/2/3/5 steps)	10 Hz to 10 MHz	1 Hz to 10 MHz	10 Hz to 10 MHz	1 Hz to 10 MHz	10 Hz to 10 MHz	1 Hz to 10 MHz	10 Hz t 10 MHz	
FFT Filter (in 1/2/3/5 steps) (see also folding page)	–	1 Hz to 1 kHz	–	1 Hz to 1 kHz	–	1 Hz to 1 kHz	–	1 H
Bandwidth error ≤3 MHz	<10%							
5 MHz	<15%							
10 MHz	+25%, –10%							
Shape factor 60:3 dB								
<1 kHz	<6							
1 kHz to 2 MHz	<15	<12	<15	<12	<15	<12	<15	
>2 MHz	<7							
Video bandwidths	1 Hz to 10 MHz in 1/2/3/5 steps							
Display range	noise floor displayed to 30 dBm							
Maximum input level								
RF attenuation 0 dB								
DC voltage	0 V							
CW RF power	20 dBm (=0.1 W)							
Pulse spectral density	97 dBµV/MHz							
RF attenuation ≥10 dB								
DC voltage	0 V							
CW RF power	30 dBm (=1 W)							
Max. pulse voltage	150 V				50 V			
Max. pulse energy (10 µs)	1 mWs				0.5 mWs			
1-dB compression of input mixer (0-dB RF attenuation)	+10 dBm nominal							
Displayed average noise floor (dBm) Frequency:	(0-dB RF attenuation, RBW 10 Hz, VBW 1 Hz, 20 averages, trace average, span 0 Hz, termination 50 Ω)							
20 Hz	–	<–80	–	<–74	–	<–74	–	<–74
1 kHz	–	<–110	–	<–104	–	<–104	–	<–104
10 kHz	<–90	<–125	<–84	<–119	<–84	<–119	<–84	<–119
100 kHz	<–110	<–135	<–104	<–129	<–104	<–129	<–104	<–129
1 MHz	<–130, typ. –135	<–145, typ. –150	<–125, typ. –130	<–142, typ. –145	<–124, typ. –129	<–142, typ. –145	<–124, typ. –129	<–142, typ. –145
10 MHz to 3.5/6 GHz	<–145, typ. –150		<–142, typ. <–147		<–138, typ. –140			
6 GHz to 7 GHz	–	–	<–139	<–139	<–135, typ. –138			
7 GHz to 18 GHz	–	–	–	–	<–138, typ. –140		<–134, typ. –139	
18 to 26.5 GHz	–	–	–	–	<–135, typ. –138		<–131, typ. –136	
26.5 GHz to 30 GHz	–	–	–	–	–	–	<–120, typ. –125	
30 GHz to 40 GHz	–	–	–	–	–	–	<–116, typ. –122	
Max. dynamic range	**10 Hz bandwidth**	**1 Hz bandwidth**	**10 Hz bandwidth**	**1 Hz bandwidth**	**10 Hz bandwidth**	**1 Hz bandwidth**	**10 Hz bandwidth**	**1 Hz bandwidth**
Displ. noise floor to 1-dB compression	155 dB	165 dB	152 dB	162 dB	150 dB	160 dB	150 dB	160 dB
Max. harmonics suppres., f >50 MHz	>90 dB							
Max. intermodulation-free range								
50 MHz to 3.5 GHz (nominal)	105 dB	115 dB	–	–	–	–	–	–
150 MHz to 7/26.5 GHz (nominal)	–	–	105 dB	115 dB	103 dB	112 dB	103 dB	112 dB
Intermodulation								
3rd-order intercept point (T.O.I.), Δf >5 × resolution BW or >10 kHz	≥12 dBm, typ. 15 dBm for f >50 MHz		≥12 dBm, typ. 15 dBm for f >150 MHz				≥12 dBm, typ. 15 dBm for f >150 MHz; ≥10 dBm for f >7 GHz	
Intermodulation-free range at –40 dBm mixer level	105 dB							
Intercept point k2 (dBm)	>25, typ. >40 for f<50 MHz, >45, typ. >50 for f >50 MHz		>25 for f <150 MHz, >35 typ. >40 for f >150 MHz, >45 typ.				>25 for f <150 MHz, >40 for f >150 MHz	
Immunity to interference								
Image frequency (dB)	>75	>80, typ.>90	>80, typ. >90					
Intermediate frequency (dB)	>80	>100	>75					
Spurious response (f >1 MHz, without input signal, 0-dB attenuation)								
Span <30 MHz	<–100 dBm	<–110 dBm	<–100 dBm	<–110 dBm	<–100 dBm	<–110 dBm	<–100 dBm	<–110 dBm
Span ≥30 MHz	<–100 dBm							
f_{in} = 25.175 MHz, 5.7172 GHz	<–100 dBm							
f_{in} = 60 MHz	<–100 dBm	<–110 dBm	<–100 dBm					
Other interfering signals (mixer level <–10 dBm)[1]	<–80 dBm[2]		<–75 dBm[2]					

[1] For models .20/.21, starting from 100 kHz carrier spacing on. [2] For models with option FSE-B23: <–50 dBm.

Specifications

	FSEA20	FSEA30	FSEB20	FSEB30	FSEM20/.21	FSEM30/.31	FSEK20/.21	FSEK30/.31
Level display								
Measurement display	500 × 400 pixels (with one diagram displayed); max. 2 diagrams with independent settings							
Log level range	10 dB to 200 dB, in steps of 10 dB							
Lin level range	10% of reference level per division (10 divisions) or logarithmic scaling							
Trace	max. 4 traces with 1 diagram, 2 traces per diagram with 2 diagrams, simultaneous measurement with all traces							
Trace detector	max peak, min peak, auto peak (normal), sample, rms, average							
Trace functions	clear/write, max hold, min hold, average							
Setting range of reference level								
Log level display	–130 dBm to 30 dBm, in steps of 0.1 dB							
Linear level display	7.0 nV to 7.07 V in steps of 1%							
Units of level axis	dBm, dBµV, dBmV, dBµA, dBpW (log and lin level display) mV, µV, mA, µA, pW, nW (linear level display)							
Level measurement error	**The values are guaranteed for bandwidths from 10 Hz to 30 kHz and 100 kHz to 10 MHz**							
–40 dBm, RF attenuation 20 dB, ref. level –15 dB, RBW 5 kHz								
Absolute error at 120 MHz	<0.3 dB							
Freq. response (10 dB RF atten.)								
<1 GHz	<0.5 dB							
1 GHz to 3.5/7 GHz	<1 dB							
7 GHz to 18 GHz	–	–	–	–		<2 dB[1])		
18 GHz to 26.5 GHz	–	–	–	–		<2.5 dB[1])		
26.5 GHz to 40 GHz	–	–	–	–	–	–	<3 dB[1])	
Attenuator error	<0.3 dB							
IF gain error	<0.2 dB (typ. 0.1 dB)							
Linearity error								
Log level display (RBW≥1 kHz, analog, S/N>15 dB)								
0 dB to –50 dB	<0.3 dB							
–50 dB to –70 dB	<0.5 dB							
–70 dB to –80 dB	<1 dB	–	<1 dB	–	<1dB	–	<1dB	–
–70 dB to –95 dB	–	<1 dB	–	<1 dB	–	<1 dB	–	<1 dB
Linear level display	5% of ref. level							
Bandwidth switching error								
1 Hz to 30 kHz/100 to 300 kHz	<0.2 dB/<0.2 dB							
1 MHz to 10 MHz	<0.3 dB							
Total measurement error (0 to –50 dB, S/N >15 dB, span/RBW <100)								
<1 GHz	<1 dB							
1 GHz to 3.5/7 GHz	<1.5 dB							
7 GHz to 18 GHz	–	–	–	–		<2.5 dB[1])		
18 GHz to 26.5 GHz	–	–	–	–		<3 dB[1])		
26.5 GHz to 40 GHz	–	–	–	–	–	–	<3.5 dB[1])	
Pulse amplitude error (single pulses)								
Bandwidth <1 MHz/≥1 MHz	<0.5 dB, nominal/<2 dB, nominal							

Trigger functions

Trigger	free run, line, video, RF, external
Delayed sweep	
Trigger source	free run, line, video, RF, external
Delay time	100 ns to 10 s, resolution 1 µs min. (or 1% of delay time)
Error of delay time	±(1 µs + (0.1% × delay time))
Delayed sweep time	2 µs to 1000 s
Gated sweep	
Trigger source	external, RF
Gate delay	1 µs to 100 s
Gate length	1 µs to 100 s, resolution min. 1 µs or 1%
Error of gate length	±(1 µs + (0.05% × gate length))
Gap sweep (span = 0 Hz)	
Trigger source	free run, line, video, RF, external
Pretrigger	1 µs to 100 s, 50 ns resolution, dependent on sweep time
Trigger to gap time	1 µs to 100 s, 50 ns resolution, dependent on sweep time
Gap length	1 µs to 100 s, 50 ns resolution

Audio demodulation

AF demodulation types	AM and FM
Audio output	speaker and phone jack
Marker stop time	100 ms to 60 s
Squelch	adjustable by means of level line

[1]) For RF frequencies >7 GHz: error after calling peaking function. For sweep times <10 ms/GHz: additional error 1.5 dB.

Specifications

	FSEA20	FSEA30	FSEB20	FSEB30	FSEM20/.21	FSEM30/.31	FSEK20/.21	FSEK30/.31
Inputs & outputs (front panel)								
RF input	N female, 50 Ω				adapter system, 50 Ω, N male and female, 3.5 mm male and female		adapter system, 50 Ω, N male and female, K male and female	
VSWR (RF attenuation >0 dB)								
f <3.5 GHz	<1.5							
f <7 GHz	–		<2.0					
f <26.5 GHz	–	–	–	–	<3		<2.5	
f <40 GHz	–	–	–	–	–	–	<2.5	
Attenuator	0 dB to 70 dB, selectable in 10-dB steps							
Probe power supply	+15 V DC, –12.6 V DC and ground, max. 150 mA							
Power supply and coding connector for antennas etc (antenna code)	12-contact Tuchel							
Supply voltages	±10 V, max. 100 mA, ground							
AF output	Z_{out} = 10 Ω, jack plug							
Open-circuit voltage	adjustable up to 1.5 V							
Inputs & outputs (rear panel)								
IF 21.4 MHz	Z_{out} = 50 Ω, BNC female, bandwidth >1 kHz or resolution bandwidth							
Level	0 dBm at reference level, mixer level >–60 dBm							
Video output	Z_{out} = 50 Ω, BNC female							
Voltage (bandwidth ≥1 kHz)	0 V to 1 V, full scale (open-circuit voltage); log scaling							
Reference frequency	BNC female							
Output, usable as input	10 MHz							
Output frequency	10 dBm nominal							
Level	1 MHz to 16 MHz, integer MHz							
Input	>0 dBm from 50 Ω							
Required level	BNC female, 0 V to 10 V, proportional to displayed frequency							
Sweep output	BNC female, 0 V and 28 V, switch-selected							
Power supply connect. f. noise source	BNC female, >10 kΩ							
External trigger/gate input	–5 V to +5 V, adjustable							
Voltage	interface to IEC-625-2 (IEEE 488.2)							
IEC/IEEE-bus control	SCPI 1994.0							
Instruction set	24-contact Amphenol female							
Connector	SH1, AH1, T6, L4, SR1, RL1, PP1, DC1, DT1, C11							
Interface functions	RS-232-C (COM 1 and COM 2), 9-contact female connectors							
Serial interface	PS/2 compatible							
Mouse interface	via IEC/IEEE bus or RS-232-C							
Plotter	HP-GL							
Plotter language	parallel (Centronics compatible) or serial (RS-232-C)							
Printer interface	5-contact DIN female for MF-2 keyboard							
Keyboard connector	25-contact Cannon female							
User interface	15-contact female							
Connector f. external monitor (VGA)								
General data								
Display	24-cm LC TFT color display (9.5")							
Resolution	640 × 480 pixels (VGA resolution)							
Pixel failure rate	<2 x 10^{-5}							
Mass memory	1.44-Mbyte 3 1/2" diskette (built-in disk drive), harddisk							
Operating temperature range								
Nominal temperature range	+5°C to +40°C							
Limit temperature range	+0°C to +50°C							
Storage temperature range	–40°C to +70°C							
Humidity	+40°C at 95% relative humidity (IEC 68–2–3)							
Mechanical stress								
Sinusoidal vibration	5 to 150 Hz, max. 2 g at 55 Hz; 0.5 g from 55 to 150 Hz; to IEC 68-2-6, IEC 68-2-3, IEC 1010-1, MIL-T-28800D, class 5							
Random vibration	10 to 300 Hz, acceleration 1.2 g_{rms}							
Shock	40 g shock spectrum, to MIL-STD-810C and MIL-T-28800D, classes 3 and 5							
Recommended calibration interval	1 year (2 years for operation with external reference)							
RFI suppression	to EMC directive of EU (89/336/EEC) and German EMC legislation							
Power supply								
AC supply	200 V to 240 V: 50 Hz to 60 Hz, 100 V to 120 V: 50 Hz to 400 Hz, class of protection I to VDE 411							
Power consumption	170 VA	180 VA	185 VA	195 VA	220 VA	230 VA	220 VA	230 VA
Safety	to EN 61010-1, UL 3111-1, CSA C22.2 No. 1010-1, IEC 1010-1							
Test mark	VDE, GS, UL, cUL							
Dimensions in mm (W x H x D)	435 × 236 × 460 (5 units of height)					435 × 236 × 570	435 x 236 x 460	435 x 236 x 570
Weight	21.5 kg	22.7 kg	21.8 kg	23.2 kg	23.8 kg	25.2 kg	24.4 kg	25.8 kg

Specifications

TV Demodulator FSE-B3

All specifications are nominal values.

Video output

Output voltage into 75 Ω	1 V_{pp}
Video polarity	positive/negative (standard switchable)
Frequency response	
0 to 4.43 MHz	–2 dB
Video S/N ratio (rms, to CCIR, level >3 mV)	55 dB
Nonlinearity in case of 10% to 75% modulation	
Differential gain	10%
Differential phase	10°
2-T-k factor	3%

Triggering

TV trigger	V/H TV sync signals, any line within a 625- or 525-line system
Standards	B/G, D/K, I, L, M

FFT Filter FSE-B5 (standard in models .30/.31)

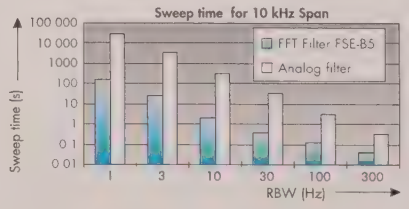
- High frequency resolution due to very small shape factor of 2.5
- Extremely short measurement time, up to 150 times faster than with conventional filters

Resolution bandwidths (RBW)

3 dB bandwidths, in 1/2/3/5 steps	1 Hz to 1 kHz
Bandwidth error	2%, nom.
Shape factor 60:3 dB	2.5, nom.

Display range for frequency axis

Min. span	25 x RBW
Max. span	100 000 x RBW, max. 2 MHz



Level measurement error
Additional
referred to RBW

Max. display range

Immunity to interference
Spurious response

External M

FSE-B21 is standard in models .

LO output/IF input (front panel)	SMA female , 50 Ω
LO signal	7.5 GHz to 15.2 GH
Amplitude	+15.5 dBm ±3 dB
IF signal	741.4 M
Max. reference level	–20
IF input (front panel)	SMA female ,
Frequency	741.4
Max. reference level	–20 dBm

Increased Level Accuracy FSE-B22

Total level error	≤0.5 dB with 10 dB RF attenuation ≤0.6 dB with 20/30/40 dB RF attenuation
Specifications are valid for:	
Temperature range	20 to 30 °C
Frequency range	10 MHz to 2 GHz
Resolution bandwidths	5 to 30 kHz/300 kHz/1 MHz
Signal level	–10 dB to –50 dB below reference level
Stop frequency	≤2 GHz
Sweep time	≥3 x auto sweep time

Broadband Output 741.4 MHz FSE-B23

FSE-B23 reduces the suppression of other interference signals to –50 dBm and must not be combined with FSE-K10/-K11.

	FSEA	FSEB	FSEM	FSEK
Gain from RF input to IF output (dB)	6	6	4	4
3 dB BW (MHz)	60	150	150[1]) 40 to 80[2])	150[1]) 40 to 120[3])

[1]) f<7 GHz. [2]) 7 GHz to 26.5 GHz. [3]) 7 GHz to 40 GHz.

Ordering information

Order designation	Type	Order No.
Spectrum Analyzer 9 kHz to 3.5 GHz	FSEA20	1065.6000.20
Spectrum Analyzer 20 Hz to 3.5 GHz	FSEA30	1065.6000.30
Spectrum Analyzer 9 kHz to 7 GHz	FSEB20	1066.3010.20
Spectrum Analyzer 20 Hz to 7 GHz	FSEB30	1066.3010.30
Spectrum Analyzer 9 kHz to 26.5 GHz	FSEM20	1080.1505.20
Spectrum Analyzer 9 kHz to 26.5 GHz	FSEM21	1080.1505.21
Spectrum Analyzer 20 Hz to 26.5 GHz	FSEM30	1079.8500.30
Spectrum Analyzer 20 Hz to 26.5 GHz	FSEM31	1079.8500.31
Spectrum Analyzer 9 kHz to 40 GHz	FSEK20	1088.1491.20
Spectrum Analyzer 9 kHz to 40 GHz	FSEK21	1088.1491.21
Spectrum Analyzer 20 Hz to 40 GHz	FSEK30	1088.3494.30
Spectrum Analyzer 20 Hz to 40 GHz	FSEK31	1088.3494.31

Accessories supplied
Power cable, operating manual, spare fuses;
FSEM: test-port adapter 3.5 mm female (1021.0512.00) and N female (1021.0535.00)
FSEK: test-port adapter K female (1036.4790.00) and N female (1036.4777.00)

Ordering information continued overleaf

Recommended extras (continued)

Order designation	Type	Order No.
Options (also see tables on folding page)		
7-GHz Frequency Extension for FSEA	FSE-B2	1073.5044.02
TV Demodulator	FSE-B3	1073.5244.02
Low Phase Noise and OCXO (for models .20/.21)	FSE-B4	1073.5396.02
FFT Filter 1 Hz to 1 kHz (for models .20/.21)	FSE-B5	1073.5544.02
Vector Signal Analyzer [1]	FSE-B7	1066.4317.02
Tracking Generator 3.5 GHz [1]	FSE-B8	1066.4469.02
Tracking Generator 3.5 GHz with I/Q Modulator [1]	FSE-B9	1066.4617.02
Tracking Generator 7 GHz [1]	FSE-B10	1066.4769.02
Tracking Generator 7 GHz with I/Q Modulator [1]	FSE-B11	1066.4917.02
Switchable Attenuator for Tracking Generator	FSE-B12	1066.5065.02
Controller for FSE, German (mouse and keyboard included)	FSE-B15	1073.5696.02
Controller for FSE, English (mouse and keyboard included)	FSE-B15	1073.5696.03
Ethernet Interface 15-contact AUI connector	FSE-B16 [2]	1073.5973.02
Thin-wire BNC connector	FSE-B16 [2]	1073.5973.03
2nd IEC/IEEE-Bus Interface for FSE	FSE-B17 [2]	1066.4017.02
Removable Harddisk	FSE-B18 [3]	1088.6993.02
Second Harddisk for FSE-B18 (firmware included)	FSE-B19	1088.7248.02
External Mixing	FSE.B21	1084.7243.02
Increased Level Accuracy up to 2 GHz	FSE-B22 [3]	1106.3480.02
Broadband Output 741.4 MHz	FSE-B23 [3]	1088.7348.02
Software		
Noise Measurement Software, Windows [1]	FSE-K3	1057.2996.02
GSM Application Firmeware, Mobile [1]	FSE-K10	1057.3092.02
GSM Application Firmware, BTS [1]	FSE-K11	1057.3392.02
Recommended extras		
Service Kit	FSE-Z1	1066.3862.02
DC Block, 5 to 7000 MHz (Type N)	FSE-Z3	4010.3895.00
DC Block, 10 kHz to 18 GHz, Type N	FSE-Z4	1084.7443.02
Microwave Measurement Cable and Adapter Set for FSEM	FS-Z15	1046.2002.02
Service Manual	–	1065.6016.24
Headphones	–	0708.9010.00
German Keyboard	PSA-Z2	1007.3001.31
American Keyboard	PSA-Z2	1007.3001.02
PS/2 Mouse	FSE-Z2	1084.7043.02
Color Monitor, 15", 230 V	PMC3	1082.6004.02
Printer, 24-pin printer head	PDN	0351.4512.04
IEC/IEEE-Bus Cable, 1 m	PCK	0292.2013.10
IEC/IEEE-Bus Cable, 2 m	PCK	0292.2013.20
19" Rack Adapter		
with front handles	ZZA-95	0396.4911.00
without front handles	ZZA-951	0396.9488.00
Set of Front Handles	ZZG-95	0396.5176.00
Transit Case	ZZK-954	1013.9395.00
Transit Case (FSEM 30/.31 and FSEK 30/.31 only)	ZZK-955	1013.9408.00
Trolley	ZZK-1	1014.0510.00
Matching Pads, 75 Ω		
L section	RAM	0358.5414.02
Series resistor, 25 Ω	RAZ	0358.5714.02
Accessories for current, voltage and field-strength measurement	see accessories for Test Receiver ESS, data sheet PD 756.9768	
SWR Bridge, 5 MHz to 3000 MHz	ZRB2	0373.9017.52
SWR Bridge, 40 kHz to 4 GHz	ZRC	1039.9492.52
High-Power Attenuators, 100 W, 3/6/10/20/30 dB	RBU 100	1073.8820.xx (xx= 03/06/10/20/30)
High-Power Attenuators, 50 W 3/6/10/20/30 dB	RBU 50	1073.8895.xx (xx= 03/06/10/20/30)
Preamplifier, 9 kHz to 30 MHz	ESH3-Z3	0827.8016.52
Preamplifier, 20 MHz to 1000 MHz	ESV-Z3	0397.7014.52
For FSEM only: Test-Port Adapter, N (male)	–	1021.0541.00
3.5 mm (male)	–	1021.0529.00
For FSEK only: Test-Port Adapter, N (male)	–	1036.4783.00
K (male)	–	1036.4802.00

1) Extra data sheet available.
2) Options FSE-B16 and FSE-B17 require option FSE-B15.
3) Cannot be retrofitted, factory-fitted only.

Fax Reply Spectrum Analyzers FSE

❑ Please send me an offer

❑ I would like a demonstration

❑ Please call me

❑ I would like to receive your free-of-charge CD-ROM catalog (including Test&Measurement Products + Sound and TV Broadcasting)

Others: _____

Name: _____

Company/Department: _____

Position: _____

Address: _____

Country: _____

Telephone: _____

Fax: _____

E-mail: _____

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ROHDE&SCHWARZ

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Certified Quality System

ISO 9001

DQS REG. NO 1954-04

Qualitätszertifikat

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

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You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to ISO 9001.

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Le système de gestion qualité de Rohde & Schwarz a été homologué conformément à la norme ISO 9001.

ROHDE&SCHWARZ

Important Hints before Operation:

For instruments without the computer function FSE-B15:

- The disks used must have been formatted by the FSE itself or by MS-DOS. Pre-formatted disks can cause errors.

For instruments with the computer function FSE-B15:

- The drives D: and Q: are reserved for system software and must not be altered. Any changes in the drives D: and Q: can cause function errors.
- When operating a PS/2 mouse, a mouse driver has to be loaded via the designated entry in the autoexec.bat file.
- The files AUTOEXEC.BAT and CONFIG.SYS are write protected. User-specific programs which are to be executed automatically during the system startup must be entered in the file C:\AUTOUSER.BAT. Network drivers for option FSE-B16 must be entered in the file C:\NETWORK.BAT.
- After switching on the instrument, the startup process can be interrupted if required. This is achieved by pressing any key on the external keyboard repeatedly until "ABORT SYSTEM BOOT [Y/N?]" is queried on the display. The instrument works then in the DOS mode.

For all instruments:

- Aborting a hardcopy is not possible when printout is in progress. Print jobs in the queue can be deleted before printout has been started by pressing the HARDCOPY START key until the message "Hardcopy in progress. Abort?" is displayed. The length of the queue is two jobs.

Safety Instructions

This unit has been designed and tested according to the standards outlined overleaf and has left the manufacturer's premises in a state fully complying with the safety standards.

In order to maintain this state and to ensure safe operation, observe the following instructions, symbols and precautions.

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   Pollution severity 2, overvoltage category 2, IP degree of protection 2X, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made (installation and cabling of the unit to be performed only by qualified technical personnel).

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.,

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

10. Any additional safety instructions given in this manual are also to be observed.

Safety-related symbols used on equipment and documentation from R&S:

Observe operating instructions	Weight indication for units >18 kg	PE terminal	Ground terminal	Danger! Shock hazard	Warning! High temperatures Warning! Hot surfaces	Ground

Patent Information

This product contains technology licensed by Marconi Instruments LTD. under US patent 4609881 and under the corresponding patent in Germany and elsewhere.

ROHDE&SCHWARZ

EC Certificate of Conformity

CE

Certificate No.: 9502002

This is to certify that:

Equipment type	Order No.	Designation
FSEA20	1065.6000.20	Spectrum Analyzer
FSEA30	1065.6000.30	
FSEB20	1066.3010.20	
FSEB30	1066.3010.30	
FSEM20	1080.1505.20	
FSEM30	1079.8500.30	
FSEK20	1088.1491.20	
FSEK30	1088.3494.30	

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electrical equipment for use within defined voltage limits (73/23/EEC revised by 93/68/EEC)

- relating to electromagnetic compatibility (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN61010-1 : 1991
EN50081-1 : 1992
EN50082-1 : 1992

Affixing the EC conformity mark as from 1995

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstr. 15, D-81671 München

Munich, 17.12.96

Central Quality Management FS-QZ / Becker

ROHDE&SCHWARZ
EC Certificate of Conformity

CE

Certificate No.: 9502052

This is to certify that:

Equipment type	Order No.	Designation
FSE-B1	1073.4990.02	Color Display
FSE-B10	1066.4769.02	Tracking Generator
FSE-B11	1066.4917.02	Tracking Generator
FSE-B12	1066.5065.02	Output Attenuator
FSE-B15	1073.5696.02/.03	Computer Function
FSE-B16	1073.5973.02/.03	Ethernet Interface
FSE-B17	1066.4017.02	2nd IEC BUS Interface
FSE-B2	1073.5044.02	7 GHz Frequency Extension
FSE-B3	1073.5244.02	TV Demodulator
FSE-B4	1073.5396.02	OCXO 10 MHz and Low Phase Noise
FSE-B7	1066.4317.02	Signal Vectoranalysis
FSE-B77	1102.8493.02	Signal-Vectoranalysis
FSE-B8	1066.4469.02	Tracking Generator
FSE-B9	1066.4617.02	Tracking Generator
FSE-Z2	1084.7043.02	PS/2 Mouse

complies with the provisions of the Directive of the Council of the European Union on the approximation of the laws of the Member States

- relating to electromagnetic compatibility
  (89/336/EEC revised by 91/263/EEC, 92/31/EEC, 93/68/EEC)

Conformity is proven by compliance with the following standards:

EN50081-1 : 1992
EN50082-1 : 1992

Affixing the EC conformity mark as from 1995

ROHDE & SCHWARZ GmbH & Co. KG
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Munich, 1997-07-15

Central Quality Management FS-QZ / Becker

Supplement A
to Operating Manual
Spectrum Analyzer FSEA20/30, FSEB20/30, FSEM20/30, FSEK20/30
(Firmware Version 1.65)

Dear Customer,

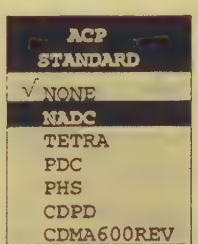
your spectrum analyzer is equipped with firmware version 1.65. The new firmware offers a number of extensions and improvements which are explained on the following pages. The new functions concern:

- Support of option FSE-B21, External Mixer Output. A separate operating manual is available for this option (stock No.: 1080.7350.15).
- Extension of the adjacent channel power measurement: The spacing for the individual channels can be set independently.
- Extension of the IEEE-bus commands for transducers.

Adjacent Channel Power Measurement

Section "Channel Configuration" of the operating manual was extended to report on the selection of the channel spacing. The extensions can be found on the following pages.

ACP STANDARD soft key activates the selection of a digital mobile-radio standard. The parameters for the adjacent channel power measurement are set according to the regulations of the selected standard.



The following standards can be selected:

NADC (IS-54 B)
TETRA
PDC (RCR STD-27)
PHS (RCR STD-28)
CDPD
CDMA800REV

The *CHANNEL SPACING* soft key opens an table for defining the channel spacing. The channel spacing is the spacing of the center frequency of a given channel relative to the center of the transmission channel.

The default setting for channel spacing is 20 kHz.

CHANNEL SPACING	
CHAN	SPACING
ADJ	20 kHz
ALT1	40 kHz
ALT2	60 kHz

Note: *Channel spacings can be selected separately for each channel. If a spacing value is changed in the table, the following values are changed automatically.*

New IEEE-Bus Commands

Firmware V1.65 was extended by the following IEEE-bus commands:

- Transducer control for handling transducer set ranges
  INITiate<1|2>:CONMeas
  [SENSe:]CORRection:TSET:BREak
  STATus:QUEStionable:TRANsducer[:EVENt]
  STATus:QUEStionable:TRANsducer:CONDition
  STATus:QUEStionable:TRANsducer:ENABle
  STATus:QUEStionable:TRANsducer:PTRansition
  STATus:QUEStionable:TRANsducer:NTRansition
- Extension of the ACP settings
  [SENSe:]POWer:ACHannel:SPACing:ACHannel
  [SENSe:]POWer:ACHannel:SPACing:ALTernate<1|2>
- File transfer between analyzer and controller
  MMEMory:DATA
- Extended description of the following commands
  SYSTem:SET
  TRACe[:DATA]

INITiate<1|2>:CONMeas

This command continues the sweep from the current sweep position.

Syntax: INITiate<1|2>:CONMeas

Example: `"INIT:CONM"`

Features: *RST value: -
SCPI: device-specific

Modes: A, VA, BTS, MS

This command is an event and therefore has no *RST value and no query. Sweeps are stopped, for example, in the case of transducer sets between the different transducer factors.

MMEMory:DATA <file_name>[,<block data>]

This command writes block data to the specified file.

Syntax: MMEMory:DATA <file_name>,<block data>
MMEMory:DATA? <file_name>

Example: `"MMEM:DATA? 'TEST01.HCP'"`
`"MMEM:DATA 'TEST01.HCP', #217This is the file"`

Features: *RST value: -
SCPI: conforming

Modes: A, VA, E, BTS, MS

Each <block> starts with the character '#', followed by the value stating the length of the length information. This is followed by one or several characters for the length information; then come the data themselves. The end character must be set to EOI to ensure correct data transmission.

[SENSe:]CORRection:TSET:BREak

This command defines if the sweep is to be stopped on changeover from range to another.

Syntax: [SENSe:]CORRection[:STATe] ON | OFF

Example: `"CORR:TSET:BRE ON"`

Features: *RST value: OFF
SCPI: device-specific

Mode: A

Prior to the above command, the command `SENS:CORR:TSET:SEL` must be sent.

[SENSe:]POWer:ACHannel:SPACing:ACHannel 0 Hz to 1000 MHz

This command defines the channel spacing of adjacent channel to carrier. This command has the same effect as `POW:ACH:SPAC`

Example: `"POW:ACH:SPAC:ACH 338kHz"`

Features: *RST value: 24 kHz
SCPI: device-specific

Modes: A-F

[SENSe:]POWer:ACHannel:SPACing:ALTernate<1|2> 0 Hz ... 1000 MHz

This command defines the spacing of the first (ALTernate1) or the second alternate adjacent channel (ALTernate2) relative to the carrier signal.

Example: `"POW:ACH:SPAC:ALT1 99kHz"`

Features: *RST value: 24 kHz
SCPI: device-specific

Modes: A-F

STATus:QUEStionable:TRANsducer[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable: TRANsducer register.

Example: `"STAT:QUES:TRAN?"`

Features: *RST value: –
SCPI: device-specific

Modes: A, VA, BTS, MS

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:TRANsducer:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable: FREQuency register.

Example: `"STAT:QUES:TRAN:COND?"`

Features: *RST value: –
SCPI: device-specific

Modes: A, VA, BTS, MS

Readout does not delete the contents of the CONDition section.

STATus:QUEStionable:TRANsducer:ENABle 0 to 65535

This command sets the bits of the ENABle section of the STATus:QUEStionable:TRANsducer register.

Example: `"STAT:QUES:TRAN:ENAB 65535"`

Features: *RST value: –
SCPI: device-specific

Modes: A, VA, BTS, MS

The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

STATus:QUEStionable:TRANsducer:PTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:TRANsducer register from 0 to 1 for the transitions of the CONDition bit.

Example: `"STAT:QUES:TRAN:PTR 65535"`

Features: *RST value: –
SCPI: device-specific

Modes: A, VA, BTS, MS

STATus:QUEStionable:TRANsducer:NTRansition 0 to 65535

This command sets the edge detectors of all bits of the STATus:QUEStionable:TRANsducer register from 1 to 0 for the transitions of the CONDition bit.

Example: `"STAT:QUES:TRAN:NTR 65535"`

Features: *RST value: –
SCPI: device-specific

Modes: A, VA, BTS, MS

SYSTem:SET <block>

The query `SYSTem:SET?` causes the data of the current instrument setting to be transmitted to the controller in binary form (SAVE function). The data can be read back into the FSE RECALL function) by means of command `SYSTem:SET` <block>. If the data records are stored on the analyzer harddisk with SAVE/RECALL (`MMEMory:STORe` or `MMEMory:LOAD`, it is possible to store the data in an external computer by means of `SYSTem:SET`.

Example: `"SYST:SET "`

Features: *RST value: –
SCPI: conforming

Modes: A, VA, BTS, MS

The receive terminator has to be set to EOI to ensure reliable transfer of data (setting `SYST:COMM:GPIB:RTER EOI`).

TRACe[:DATA] TRACE1| TRACE2| TRACE3| TRACE4, <block> | <numeric_value>

This command transfers trace data from the controller to the instrument, the query reads trace data out of the instrument.

Example: `"TRAC TRACE1,"+A$` (A$: data list in the current format)
`"TRAC? TRACE1"`

Features: *RST value: -
SCPI: conforming

Modes: A, VA, BTS, MS

The trace data are transferred in the current format (corresponding to the command FORMat ASCii | REAL | UINT). The device-internal trace memory is addressed using the trace names 'TRACE1' to 'TRACE4'.The parameter of the query is the trace name TRACE1 to TRACE4, it indicates which trace memory will be read out.

The transfer of trace data from the controller to the instrument takes place by indicating the trace name and then the data to be transferred. In ASCII format, these data are values separated by commas. If the transfer takes place using the format real (REAL 32), the data are transferred in block format.

Saving and recalling trace data to/from the device-internal hard disk or to/from a floppy is controlled via the commands "`MMEMory:STORe:TRACe`" and "`MMEMory:LOAD:TRACe`" respectively.

The transfer format for the trace data depends on the instrument setting

Analyzer mode (span >0 and zero span):

500 results are output in the unit selected for display.

Note: *With AUTO PEAK detector, only positive peak values can be read out. Trace data can be read into FSE with logarithmic display only in dBm, with linear display only in volts.*

FORMAT REAL,32 is to be used as format for binary transmission.

Vector analyzer mode, digital demodulation

The number of data transferred (except for the symbol table) is determined by the following formula

number of results = result length * points per symbol

Max. 6400 results can be transferred (for example result length 1600, points per symbol 4).

In all Cartesian diagrams (MAGNITUDE CAP BUFFER, MAGNITUDE, PHASE, FREQUENCY, REAL/IMAG, EYE[I], EYE[Q], ERROR VECT MAGNITUDE) test data are transferred in the unit selected for display.

FORMAT REAL,32 is to be used for binary transmission.

Note: *In the case of the eye pattern, results are simply superimposed in the display, i.e. the EYE representation is the same as the REAL/IMAG representation.*

In the polar diagrams (POLAR CONSTELL, POLAR VECTOR) the real and the imaginary component are transferred as a pair for each result.

FORMAT REAL,32 is to be used for binary transmission.

With the SYMB TABLES / ERRORS setting, the displayed symbols can be read out as traces. Trace assignment is as follows:

Full screen Trace 1
Split screen, screen A: Trace 1
Split screen, screen B: Trace 2

One byte (8 bits) is read out for each symbol.

FORMAT UINT,8 is to be used for binary transmission.

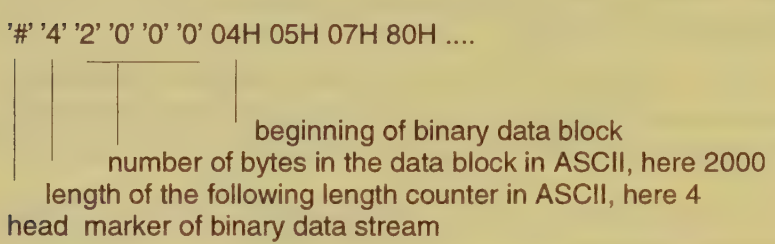
Vector analyzer mode, analog demodulation

The number of results transferred depends on the SWEEP TIME and DEMOD BW settings. Max. 5000 and min. 10 points are available. The unit for the results depends on the selected demodulation:

AM	unit %
FM	unit Hz
PM	unit rad or deg

FORMAT REAL,32 is to be used for binary data transmission.

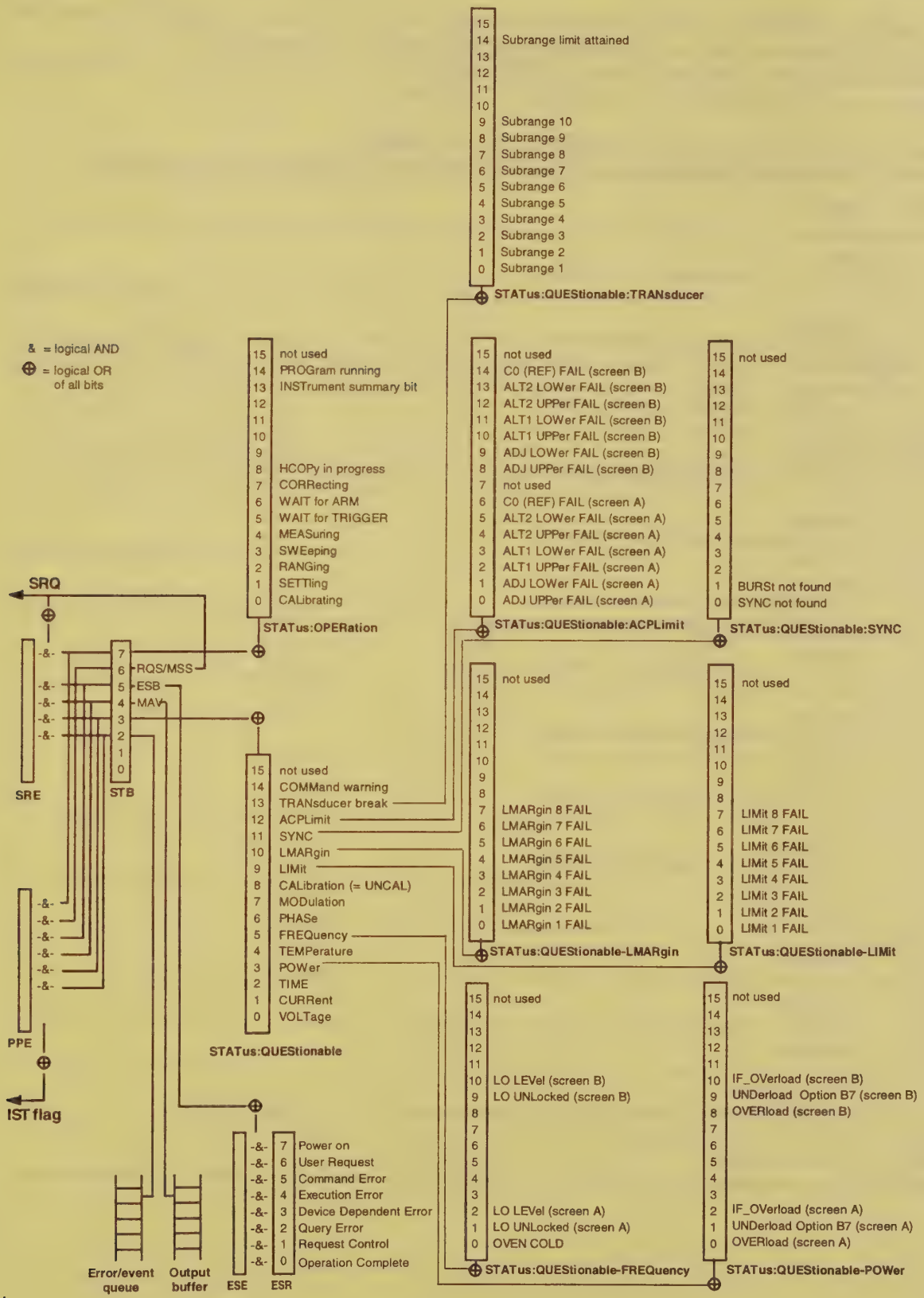
If, e.g., the format „`FORM REAL, 32`“ is selected, the data transferred from the instrument to the controller in the analyzer mode has the following structure:


'#' '4' '2' '0' '0' '0' 04H 05H 07H 80H ....
beginning of binary data block
number of bytes in the data block in ASCII, here 2000
length of the following length counter in ASCII, here 4
head marker of binary data stream

In this example, the number of data bytes transferred is calculated as follows:

Number	=	number of points	* Bytes/value
2000	=	500	* 4

Extension of Status Registers for Transducers



STATus QUEStionable:TRANsducer Register

This register indicates that a transducer hold point is attained (bit 15) and what range is to be swept next (bit 0 to 10). The sweep can be continued with command `INITiate:CONMeasure`.
It can be queried with commands `STATus:QUEStionable:TRANsducer:CONDition?` and "`STATus:QUEStionable:TRANsducer[:EVENt]?`.

Meaning of bits in STATus: QUEstionable:TRANsducer register

Bit No.	Meaning
0	**Range 1** This bit is set when subrange 1 is attained.
1	**Range 2** This bit is set when subrange 2 is attained.
2	**Range 3** This bit is set when subrange 3 is attained.
3	**Range 4** This bit is set when subrange 4 is attained.
4	**Range 5** This bit is set when subrange 1 is attained.
5	**Range 6** This bit is set when subrange 6 is attained.
6	**Range 7** This bit is set when subrange 7 is attained.
7	**Range 8** This bit is set when subrange 8 is attained.
8	**Range 9** This bit is set when subrange 9 is attained.
9	**Range 10** This bit is set when subrange 10 is attained.
10	**not used**
11	**not used**
12	**not used**
13	**not used**
14	**Subrange limit** This bit is set when the transducer is at the point of changeover from one range to another.
15	This bit is always 0.

Supplement
to Data sheet

Spectrum Analyzer
FSEA 20, FSEB 20, FSEM 20, FSEK 20 without Option B4

Spectral Purity

The values for the spectral purity at carrier offsets of 10kHz and smaller are valid with Main PLL Bandwidth medium. This bandwidth is set automatic to this value with span <= 50kHz and resolution bandwidth < 1kHz. With other settings the Main PLL Bandwidth can be set to medium via the softkey "Main PLL BW".

.

The value for the spectral purity at carrier offsets of 100kHz are valid with Span / Sweeptime of smaller than 0.4 MHz / ms with FSEA´s and 0.8 MHz / ms with FSEB, FSEM and FSEK.

Spurious response

others (mixer level <= -10dBm)

	FSEA20	FSEB20/FSEM20/FSEK20
frequency-offset <= 110kHz	-70dBc	-65dBc
frequency-offset > 110kHz	-80dBc	-75dBc

1 Preparing for Operation

Chapter 1 presents the front and rear view of the instrument and explains step by step how to set up and connect the FSE.

1.1 Description of Front and Rear Panel Views

1.1.1 Front View

1

Display Screen — see Chap.2, Section 2.3.1

2

Soft Keys — see Chap.2, Section 2.3

3 USER

Writing Macros — see Chap. 2, Section 2.8

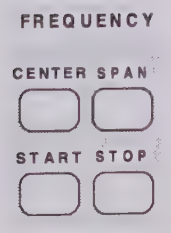
4 MARKER

Select and set marker

NORMAL	Select and set the marker
SEARCH	Set and start the peak/min search
DELTA	Select and set the delta marker
MKR ⇒	Set the active marker

see Chap. 2, Section 2.2 and Section 2.9.3

5 FREQUENCY



Define frequency axis in the active window

CENTER	Set center frequency
SPAN	Set sweep width
START	Set start frequency
STOP	Set stop frequency

see Chap. 2, Section 2.2 and Section 2.9.1

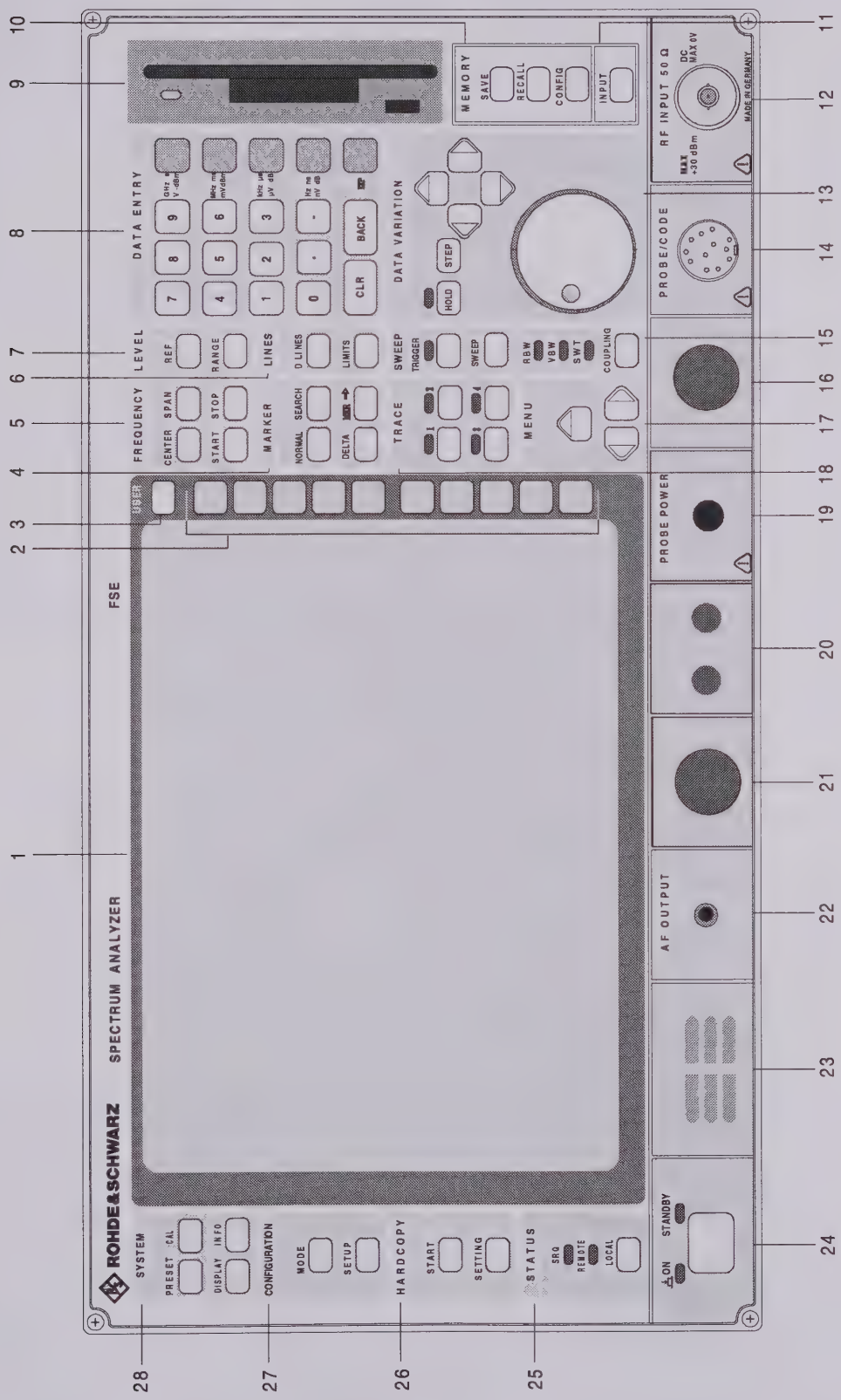


Figure 1.1-1 Front View

6 LINES

Setup evaluation lines and tolerance limits

D LINES	Setup evaluation lines (display lines)
LIMITS	Definition and recall of tolerance limits

see Chap. 2, Section 2.2 and Section 2.9.4

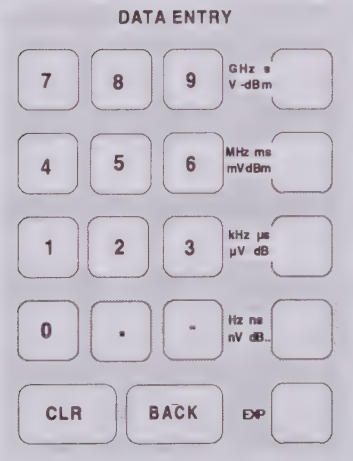
7 LEVEL

Define reference levels and display range in the active measurement window.

REF	Set reference level (= max. display level)
RANGE	Set range

see Chap.2, Section 2.2 and Section 2.9.2

8 DATA ENTRY



Keypad for data input

0...9	input numbers
.	input decimal point
–	change sign
CLR	– close input field (for uncompleted or already closed inputs, the original entry is kept) – erase the current entry in input field (beginning of an input) – close message window (status, error and warning messages)
BACK	erase last character input
GHz s V -dBm MHz ms mV dBm kHz µs µV dB.. Hz ns nV dB	The units keys close the data input and define the multiplication factor for each basic unit. For dimension-less or alphanumeric inputs, the units keys have weight 1. They behave, in this case, like the ENTER key.
EXP	Append an exponent

see Chap.2, Section 2.3

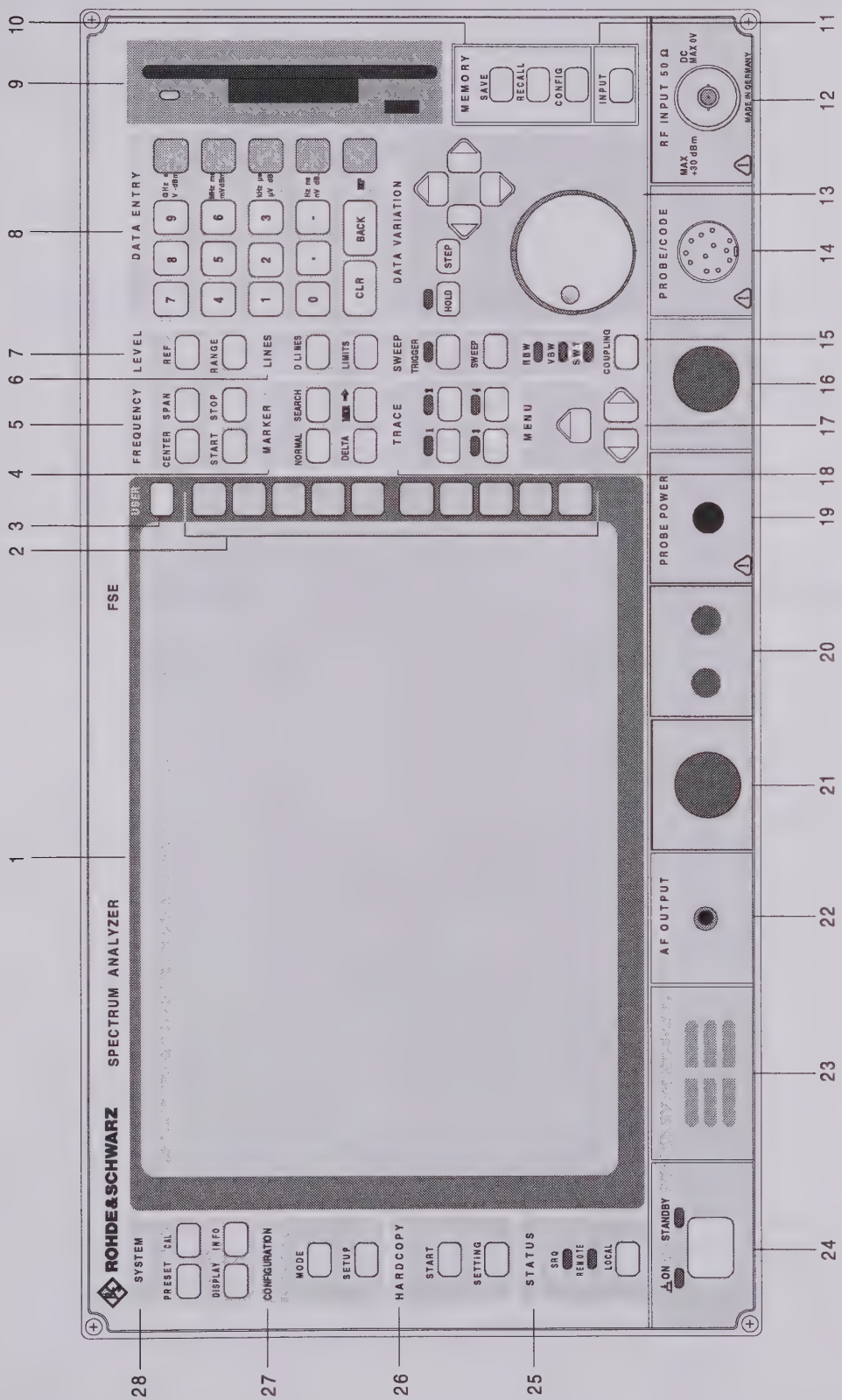


Figure 1.1-1 Front View

9

3 1/2" diskette drive; 1.44 MByte

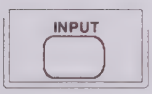
10 MEMORY

Memory media and file management

SAVE	Save instrument data
RECALL	Recall instrument data
CONFIG	Configuration of memory media and data

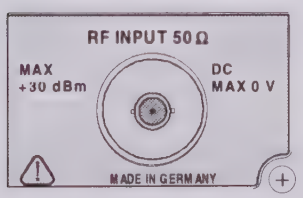
see Chap. 2, Section 2.2 and Section 2.7

11 INPUT



Set impedance and attenuation at the RF input.

12 RF INPUT

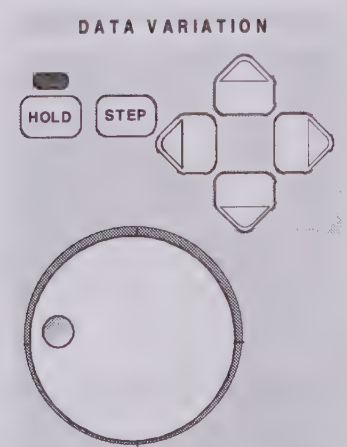


RF-Input

Caution:
The maximum DC voltage is 0 V, the maximum power is 1 W (≙ 30 dBm at ≥ 10 dB attenuation)

see Chap. 2 Section 2.9.2.4

13 DATA VARIATION



Key group for entering data and for cursor movement

HOLD	Disable control elements / overall control. The LED indicates the hold condition.
STEP	Set step size for cursor keys and roll-key.
Cursor keys	– Move the cursor within the input fields and tables. – Vary the input value. – Define the direction of movement for the roll-key.
Roll-key	– Vary input values. – Move markers and limits. – Select letters in the help line editor. – Move cursor in the tables

see Chap. 2, Section 2.3

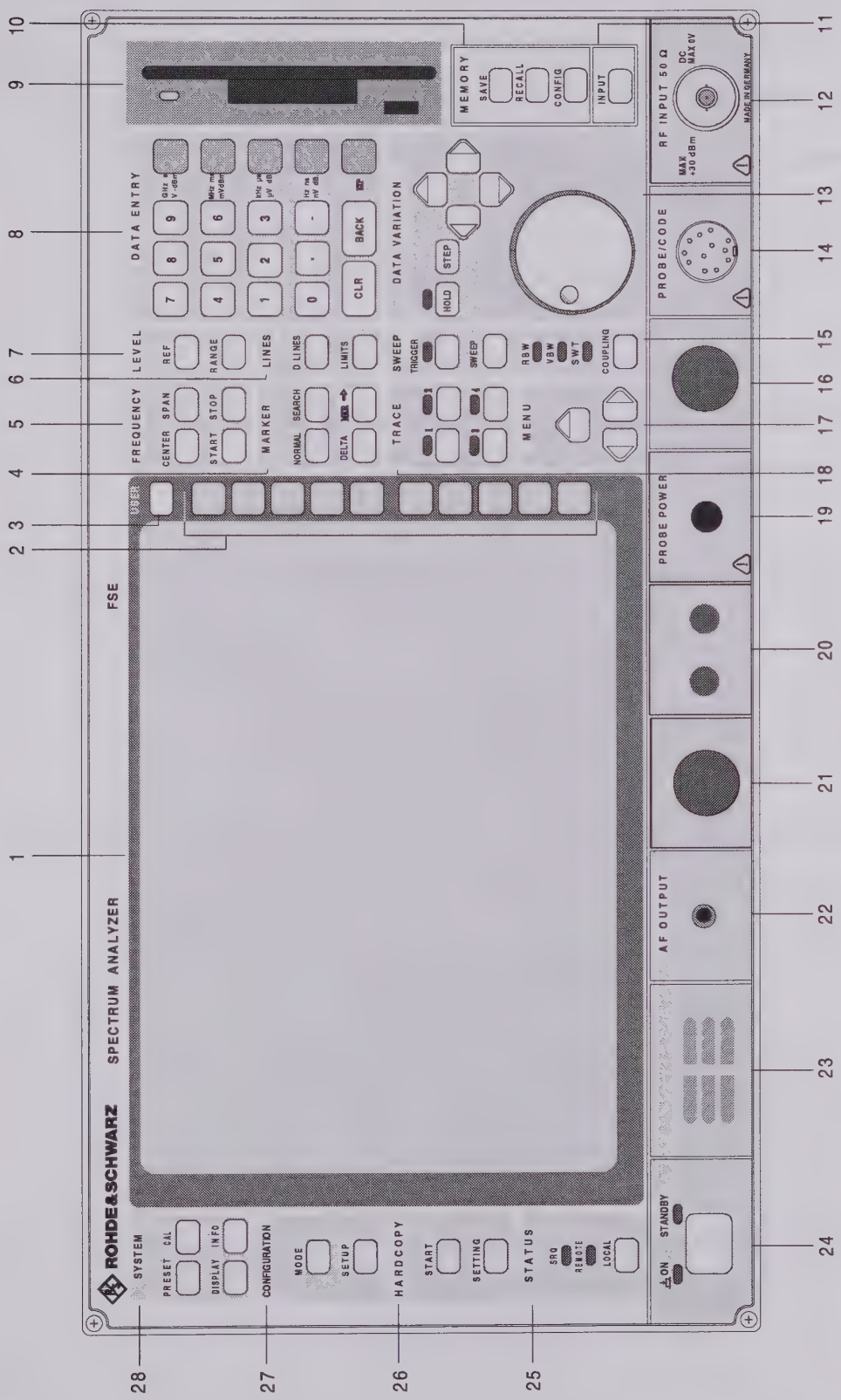
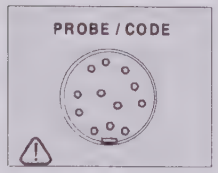


Figure 1.1-1 Front View

14 PROBE/CODE



Power supply and coded socket for R&S accessories.(12-pin Tuchel)

15 SWEEP

Input sweep parameters

TRIGGER Set trigger source. The LED illuminates on valid trigger.

SWEEP Set type of sweep.

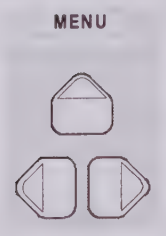
COUPLING Set coupled parameters. Resolution BandWidth (RBW), Video BandWidth (VBW) and SWeep Time (SWT). The LEDs light indicating coupled parameters which are manually cancelled.

see Chap. 2, Section 2.2 and Section 2.9.6

16

Reserved for options

17 MENU



Menu-change keys

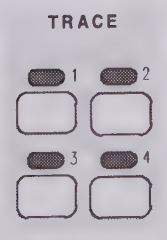
Call main menu

Change to left menu

Change to right menu

see Chap. 2, Section 2.3.2

18 TRACES



Select and activate measurement traces (Trace 1...4).

The LEDs indicate traces turned on.

see Chap. 2, Section 2.2 and Section 2.9.5

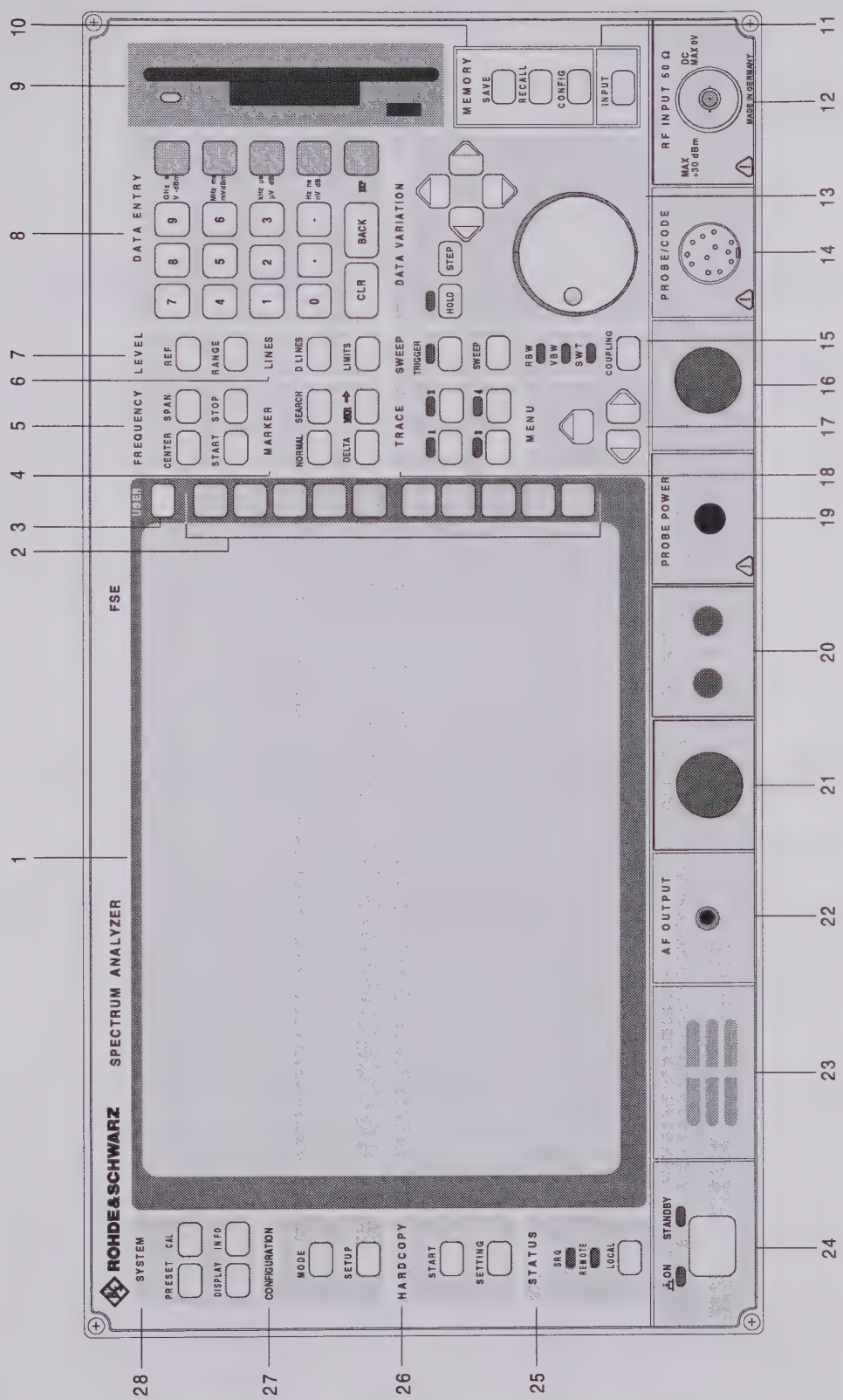
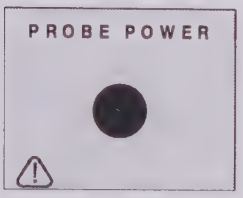


Figure 1.1-1 Front View

19 PROBE POWER



Power supply connector (+15V / - 12.6V) for measurement accessories (probes)

see Annex A

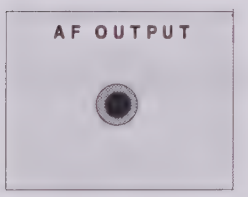
20

Reserved for options

21

Reserved for options

22 AF OUTPUT



AF output connector (head phones) (miniature phone jack)

see Annex A

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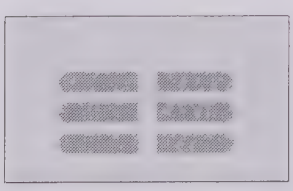
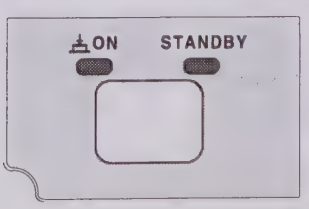


Internal loudspeaker

The loudspeaker is disabled when the phone jack is inserted in the AF output.

see Annex A

24



ON/STANDBY

Caution:
In standby mode, the AC line voltage is still present within the instrument.

see Chap. 1, Section 1.2.6

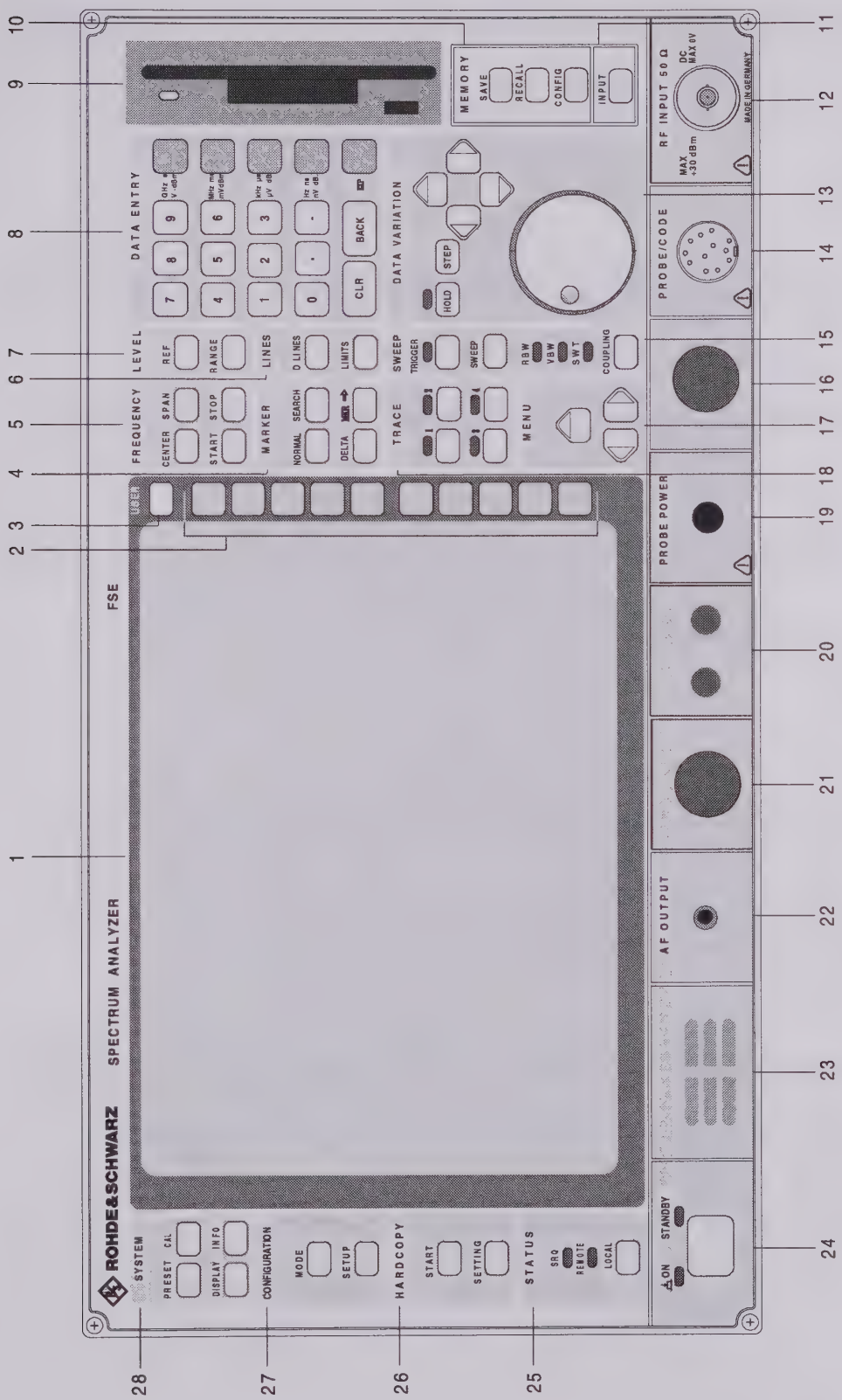


Figure 1.1-1 Front View

25 STATUS

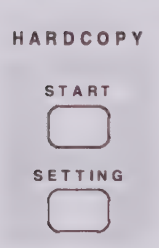
Indicators for remote control and switch for manual control.

LOCAL — Switch from remote to manual control.

The LED SRQ indicates that a service request from the instrument is active on the IEC Bus.
The LED REMOTE indicates that the instrument is under remote control.

see Chap. 2, Section 2.5 and Chap. 3, Section 3.3

26 HARDCOPY



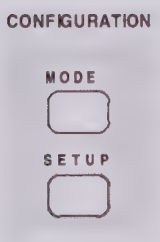
Printer control

START — Start a print job with the setup defined in the SETTING menu.

SETTING — Configure the diagram, parameter list and measurement protocol outputs on the various output media.

see Chap. 2 Sections 2.2 and 2.6

27 CONFIGURATION



Select operational modes and define default settings

MODE — Select mode

SETUP — Define configurationss

see Chap. 1, Sections 1.3 to 1.6 and Chapter 2, Section 2.2 and Sections 2.4.5 to 2.4.6

28 SYSTEM

General instrument default settings

PRESET — Recall instrument default settings

DISPLAY — Configure the display screen format

CAL — Calibrate the analyzer

INFO
- Information concerning instrument state and measurement parameters
- Call help functions

see Chap. 2 Section 2.2 and Sections 2.4.1 to 2.4.4

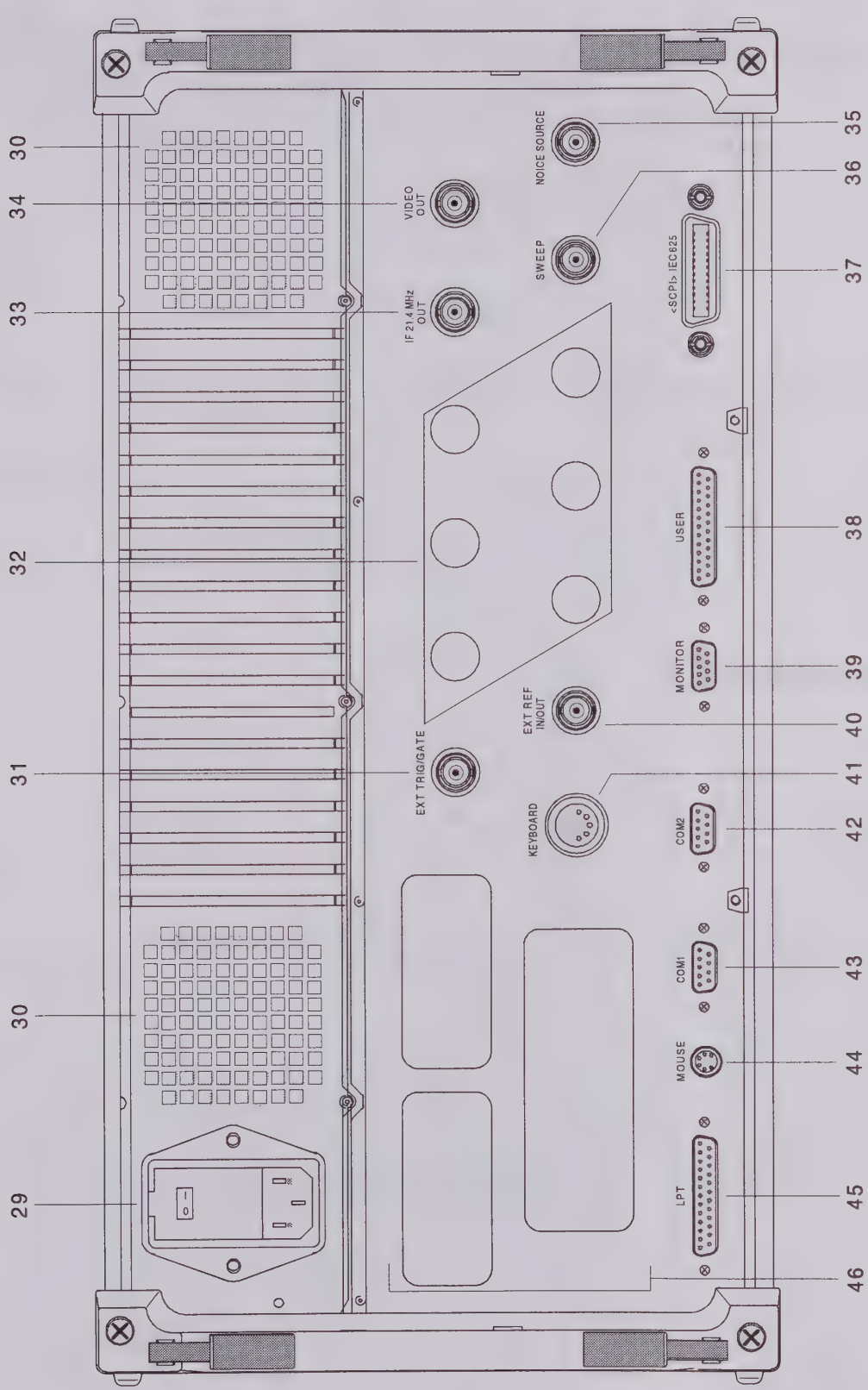
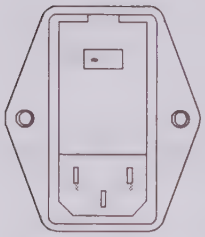


Figure 1.1-2 Rear View

1.1.2 Rear View

29



Power switch

Fuse holder

AC power connector

see Chap. 1, Section 1.2.4

30

Power supply fans

31 EXT TRIG/GATE

EXT TRIG/GATE

Input connector for an external trigger or an external gate signal

see Chap. 2, Section 2.9.6 and Annex A

32

Reserved for options

33 IF 21.4 MHZ OUT

IF 21.4 MH: OUT

Output connector for 21.4 MHz IF

see Annex A

34 VIDEO OUT

VIDEO OUT

Output connector for video signal

see Annex A

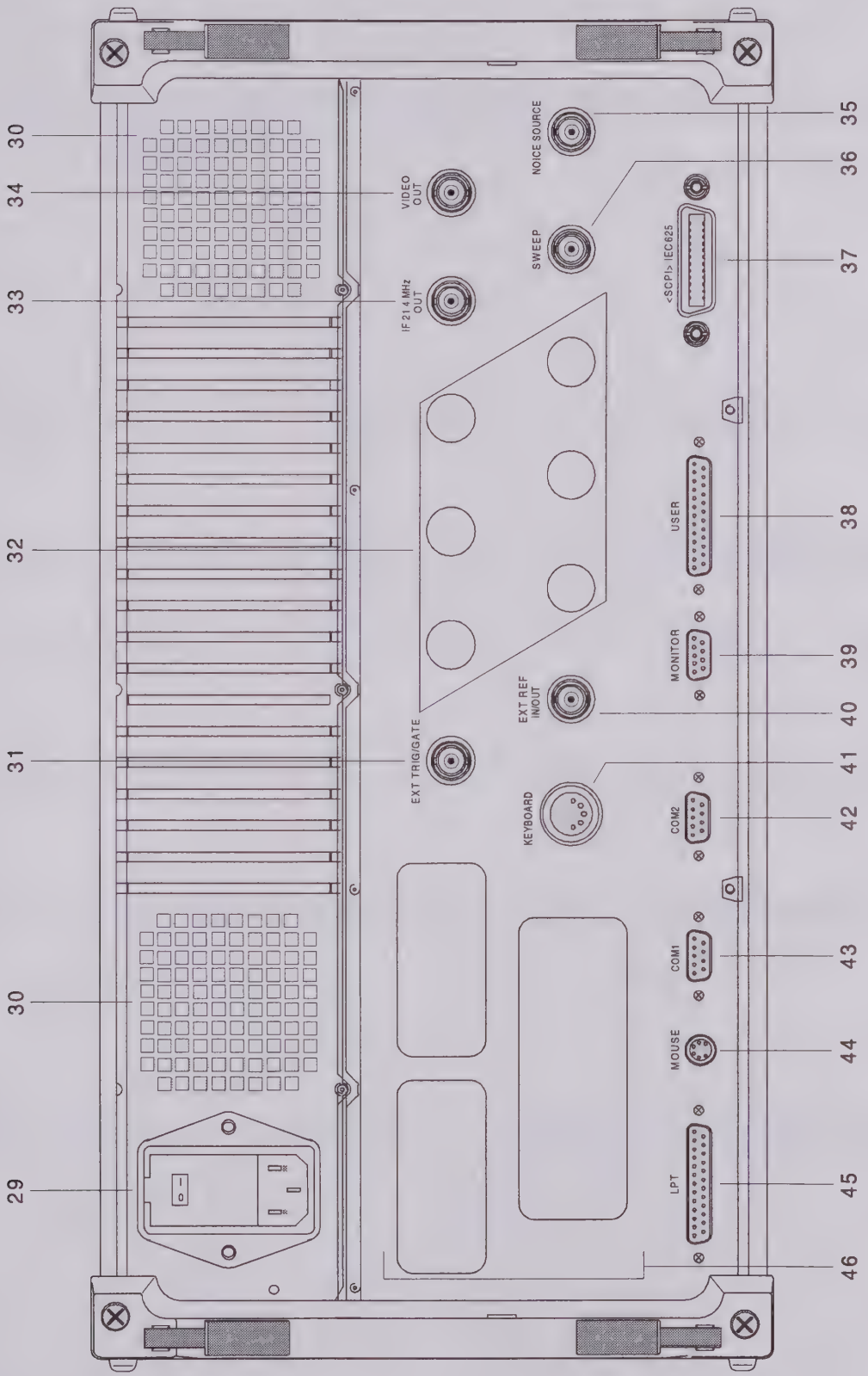


Figure 1.1-2 Rear View

35 NOISE SOURCE

NOICE SOUF

Output connector for a switchable noise source

see Annex A

36 SWEEP

SWEEP

Output connector

During a sweep, a sawtooth voltage is output which is proportional to frequency.

see Annex A

37 <SCPI> IEC625

<SCPI> IEC625

IEC Bus-connector

see Annex A

38 USER

USER

User interface connector with configurable inputs and outputs (USER-PORT A and USER-PORT B)

see Annex A

39 MONITOR

MONITOR

Connector for an external VGA monitor

see Annex A

40 EXT REF IN/OUT

EXT REF IN/OUT

Input connector for an external reference (1 to 16 MHz), switchable to 10 MHz output

see Chap. 2, Section 2.4.6.2 and Annex A

41 KEYBOARD

KEYBOARD

Connector for an external keyboard (5-pin DIN socket)

see Chap. 1 Section 1.5 and Annex A

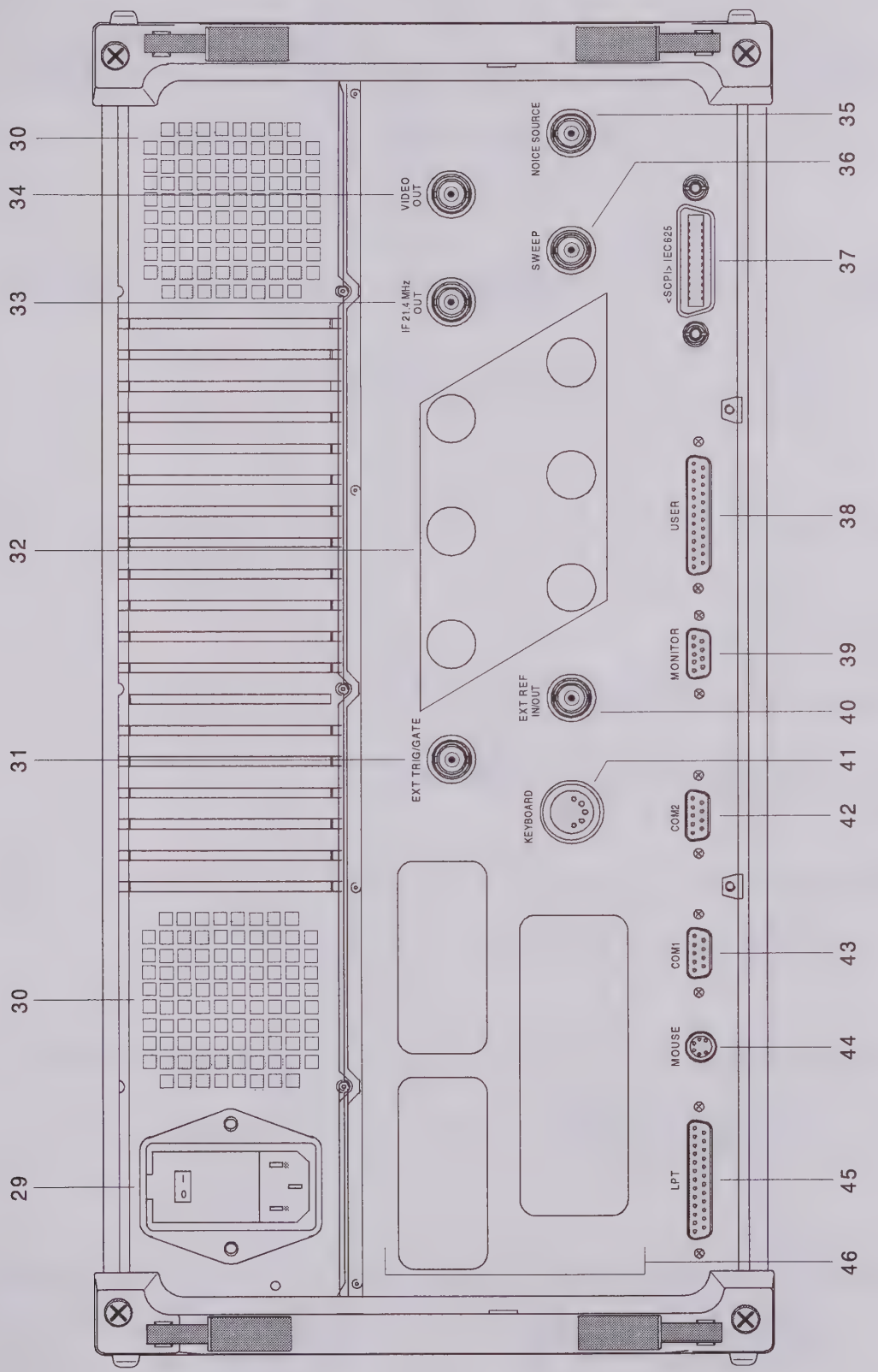


Figure 1.1-2 Rear View

42 COM2

Connector for serial interface 2
(9-pin socket; COM2)

see Chap. 1
Section 1.6
and
Annex A

43 COM1

Connector for serial interface 1
(9-pin socket; COM1)

see Chap. 1
Section 1.6
and
Annex A

44 MOUSE

Connector for a PS/2 mouse

see Chap.1
Section 1.4
and
Annex A

45 LPT

Parallel interface connector
(printer connector, Centronics compatible)

see Chap. 1
Section 1.6
and
Annex A

46

Inputs / Outputs for options
(cover plates for digital interface expansion)

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1.2 Start-Up

Important Note:

Before turning the instrument on, it must be observed that the following conditions are fulfilled:

- *instrument covers are in place and all fasteners are tightened,*
- *fan openings are free from obstructions,*
- *signal levels at the input connectors are all within specified maximums,*
- *signal outputs are correctly connected.and not overloaded.*

***Non-observance may cause damage to the instrument*.**

1.2.1 Unpacking the Instrument

After the instrument has been removed from its packaging, insure that all deliverable items are present as follows:

- spectrum analyzer
- AC power cable
- operating manual

Now check the instrument for visible mechanical damage. If damage is present, promptly inform the delivery firm that delivered the instrument. In case damage is found, retain the carton and the packing materials.

1.2.2 Instrument Setup

1.2.2.1 Stand-alone Operation

The instrument is designed for use under general laboratory conditions. The ambient conditions required at the operational site are as follows:

- The ambient temperature must be in the range of + 5 to + 45 °C.
- All fan openings must be unobstructed and the air exhaust at the rear panel and at the side-panel perforations must not be covered. The distance to the wall should be at least 10 cm.
- The mounting surface should be flat.

  For applications in the laboratory or on a work bench, it is recommended that the support feet on the bottom of the instrument be extended. For the LCD display, this provides the optimum viewing angle which typically ranges from perpendicular to the display front to approximately 30° below.

1.2.2.2 19" Rack Installation

Important Note:

For rack installation, insure that the air flow at the side-panel perforations and the air exhaust at the rear panel are not obstructed.

The instrument may be mounted in a 19" rack by using the rack adapter kit ZZA-95 (order number: 396.4911.00). The installation instructions are included in the adapter kit.

1.2.3 EMI Protection Measures

In order to prevent electromagnetic interference (EMI), the instrument may be operated only when all covers are correctly in place. Only adequately shielded signal and control cables may be used (see recommended accessories).

1.2.4 Connecting to AC Power

The FSE is equipped with an AC voltage selection feature and will automatically set itself according to the applied AC voltage (range: 90 to 132 VAC and 180 to 265 VAC, 47 to 440 Hz). The AC power connector is located on the rear panel (see below).

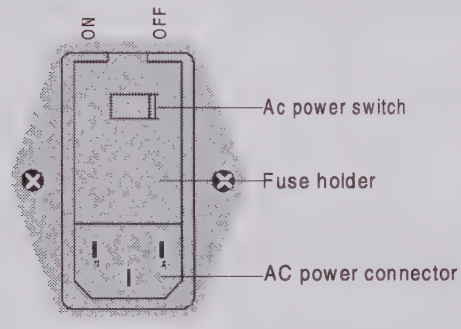
➢ Connect the instrument to the AC power source using the AC power cable delivered with the instrument.

1.2.5 AC Power Line Fuses

The FSE is protected by two fuses as specified on the power supply name-plate. The fuses are located in a removable fuse holder which is located between the AC power switch and the AC power connector (see below).

1.2.6 Instrument On/Off

AC power switch on the rear panel



Power On/Off

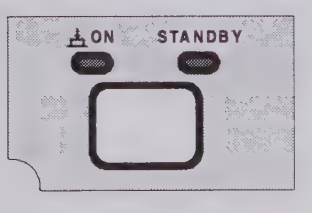
➢ Depress the AC Power Switch to the desired position ON/OFF.

After turn-on (position ON), the instrument is in the ready state (STANDBY) or in operation dependent upon the position of the ON/STANDBY switch located on the instrument front panel (see below).

Note: *The AC power switch may remain ON continuously. Switching to OFF is only required when the instrument must be completely removed from the AC power source.*

Switching to OFF (position OFF) removes all instrument circuitry from the AC power source.

ON/STANDBY switch on the front panel



Caution:

In standby mode, the AC power voltage is present within the instrument.

Standby

➢ ON/STANDBY switch is not depressed.

The yellow LED (STANDBY) is illuminated. The DC power supply is supplied with power and the quartz oven is maintained at normal operating temperature.

Operation

➢ ON/STANDBY is depressed.

The green LED (ON) is illuminated. The instrument is ready for operation. All modules within the instrument are supplied with power.

1.2.7 Battery-Powered Memory

The FSE is equipped with a battery-powered read/write memory (CMOS-RAM) where instrument settings are saved at power-off. After each power-on, the FSE is reloaded with the operational parameters which were active just prior to the last power-off (STANDBY or AC power OFF).

A lithium battery is used to supply power to the CMOS-RAM. When the battery is depleted (expected life is approx. 5 years), any data stored in CMOS-RAM will be lost. In this case, the factory standard setup is loaded at turn-on. Changing batteries is described in Chapter 4, Section "Changing Batteries" .

1.3 Functional Test

After turning on the AC power, the FSE returns the following message to the display screen:

Analyzer BIOS
Rev.x.y

Copyright
Rohde & Schwarz
Munich

Booting

After appearance of the above message, a self-test of the digital hardware is performed. Any errors which occur in self-test are transferred as ASCII text to the printer interface (LPT). Thus, an error diagnosis can be carried out, even for serious failures. A check of the data contents of the spectrum analyzer is performed in self calibration (CAL, *CAL TOTAL* key) The individual results of the calibration (PASSED / FAILED) can be displayed in the calibration menu.
With the aid of the built-in self-test functions (*INFO* key, *SELFTEST* soft key), the functional integrity of the analyzer can be verified and/or defective modules can be localized.

1.4 Connecting a Mouse

Caution:
The mouse may only be connected when the instrument is switched off (STANDBY). Otherwise, correct operation of the mouse and instrument cannot be guaranteed.

In order to ease manual operations, the FSE provides an option for connecting a mouse to a PS/2 mouse (MOUSE) or a serial interface (COM1 or COM2) connector.

During measurement operation, soft keys, tables and data input fields may also be controlled via the mouse. With the installed option FSE-B15, the mouse can be selectively assigned to measurement instrument operation, DOS operation or both modes of operation. If the option FSE-B15 is not installed, then the mouse can only be assigned to measurement instrument operation.

The control functions for the mouse are described in Chapter 2 in the section "Mouse Operations". Appendix E contains a list in which the screen display elements for mouse control of the corresponding soft keys and push buttons of the instrument are described. Appendix A contains the interface description.

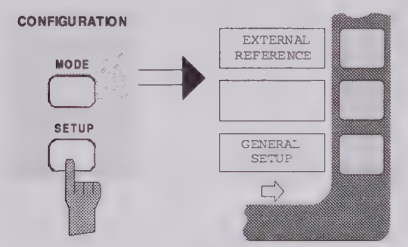
The Microsoft mouse is the supported mouse type and is available under option PS-B1 (order number 1006.6359.02). The mouse connectors are located on the rear panel.

After connection of the mouse, the selected interface must be configured and the mouse assigned to either single or dual mode of operation.

The configuration is performed according to menu *SETUP-GENERAL SETUP* (key group: *CONFIGURATION*, see in Chapter 2, the section "Preliminary Setup and Interface Configuration").

- The parameter *MOUSE INTERFACE* configures the selected interface.
- The parameter *MOUSE OWNER* assigns the mouse to either single or dual mode of operation.

In the following illustrative example, the mouse is connected to the PS/2 interface and is assigned to the dual mode of operation.



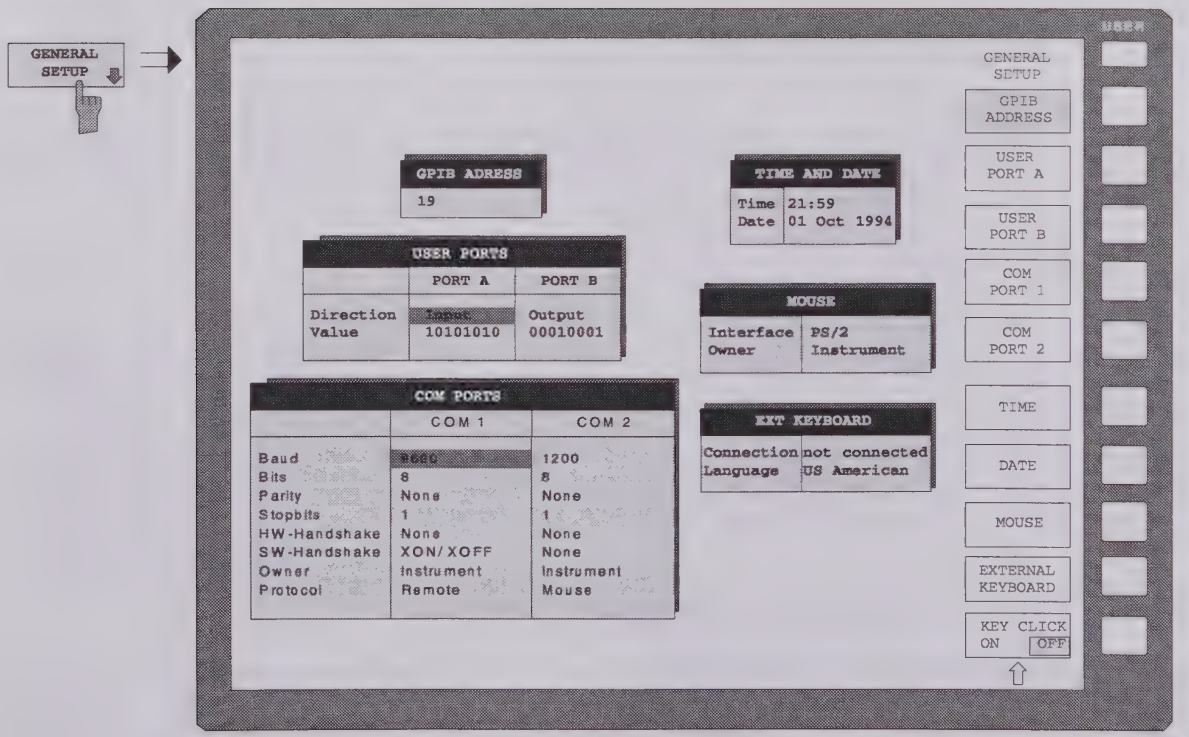
Select SETUP-GENERAL SETUP menu

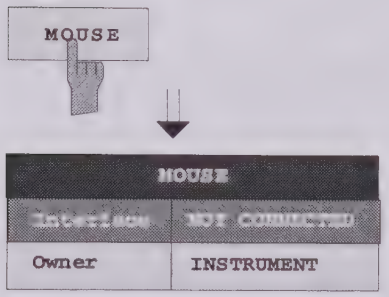
➢ Press the *SETUP* key in the *CONFIGURATION* key group.

The *SETUP* menu is opened.

➢ Press the *GENERAL SETUP* soft key.

The *GENERAL SETUP* sub-menu is opened and the current settings of the general instrument parameters are displayed in tabular form on the display screen.

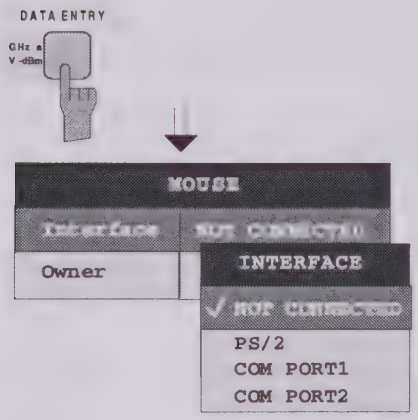




Select interface

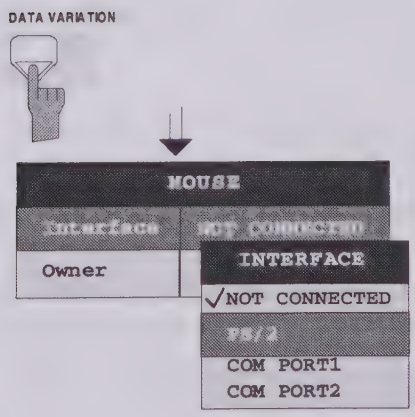
➢ Press the *MOUSE* soft key.

The *INTERFACE* parameter in the *MOUSE* table is marked by the selection bar.

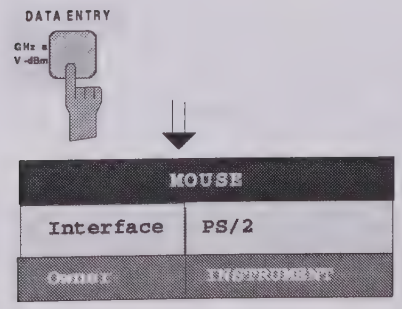


➢ Press one of the units keys.

The *INTERFACE* selection box appears on the display screen. The current state (*NOT CONNECTED*) is indicated by a check mark and the selection bar is in the background.

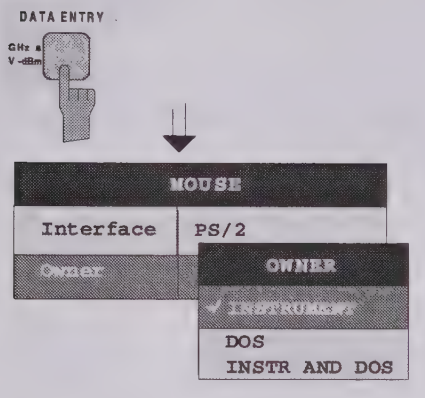


➢ Press the cursor key ⓘ until the entry PS/2 is indicated by the selection bar.



➢ Press one of the units keys.

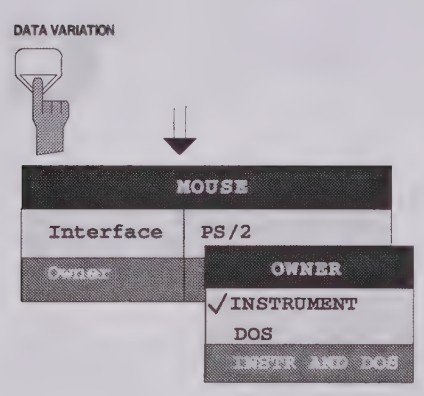
The *INTERFACE* selection box is closed, the setting PS/2 is entered in the MOUSE table and the selection bar is automatically set to the OWNER parameter.



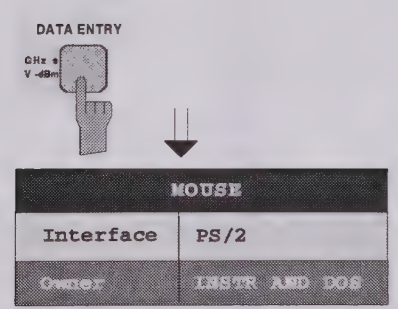
Assign mouse mode

➢ Press one of the units keys.

The *OWNER selection box appears on the display screen. The current state (INSTRUMENT) is indicated by a check mark* and the selection bar is in the background.



➢ Press the cursor key ⓘ until the entry *INSTR AND DOS* is indicated by the selection bar.



➢ Press one of the units keys.

The *OWNER* selection box is closed and the setting *INSTR AND DOS* is entered in the MOUSE table.

The mouse is now installed and is available in both the measurement instrument and DOS modes.

Return to main menu

➢ Press the menu-change key several times.

1.5 Connecting an External Keyboard

Caution:
The keyboard may only be connected when the instrument is switched off (STANDBY). Otherwise, correct operation of the keyboard cannot be guaranteed.

The FSE provides an option for connecting an external PC keyboard to the 5-pin DIN connector at the rear panel.

During measurement operations, the keyboard simplifies the input of commentary text, filenames, etc. If the option FSE-B15 (computer function) is installed, the keyboard has the usual DOS-mode functions.

Note: *Using the key combination <ALT><S-Abf> (German keyboard) or <ALT><SYSREQ> (US-keyboard), the representation on the display screen can be rapidly toggled between the measurement instrument and the DOS display formats.*

Appendix E contains a list which describes the assignment of the FSE front-panel key functions to the key codes of the external keyboard as well as special key combinations used for quick operations. Appendix A contains the interface dscription.

The keyboard connection (KEYBOARD) is located on the rear panel.

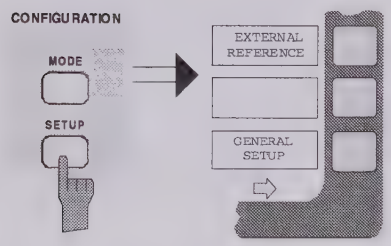
After connecting the keyboard, the connection must be entered into the instrument and the key assignments for measurement instrument operations must be determined.

The configuration takes place in the menu *SETUP-GENERAL SETUP* (key group: *CONFIGURATION, see in Chapter* 2, the section "Preliminary Setup and Interface Configuration").

- The parameter *EXT KEYBOARD CONNECTION* informs the instrument that an external keyboard is connected.
- The parameter *EXT KEYBOARD LANGUAGE* sets the keyboard language definition for measurement instrument operation (*US-AMERICAN* or *GERMAN*).

  Note: *During measurement instrument operation, the key combination <ALT> <F1> can be used to toggle the language definition.*

In the following illustrative example, the instrument is informed that a keyboard has been connected. The GERMAN keyboard definition is selected.



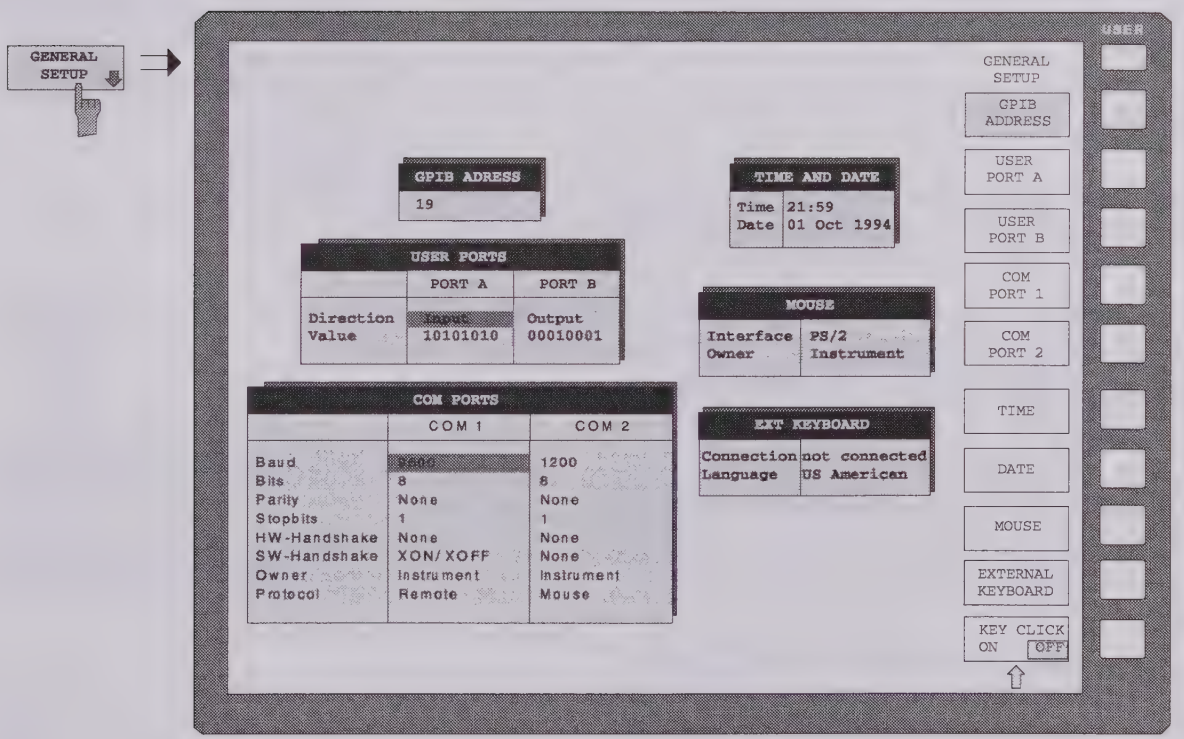
Call SETUP-GENERAL SETUP menu

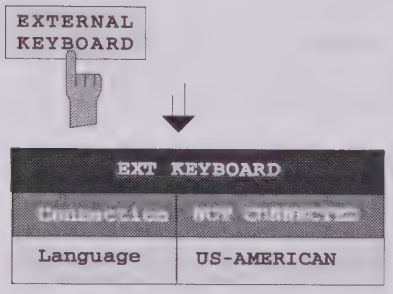
➢ Press the *SETUP* key of the *CONFIGURATION* key group.

The *SETUP* menu is opened.

➢ Press the *GENERAL SETUP* soft key.

The *GENERAL SETUP* sub-menu is opened and the current settings of the general instrument parameters are shown in tabular form on the display screen.

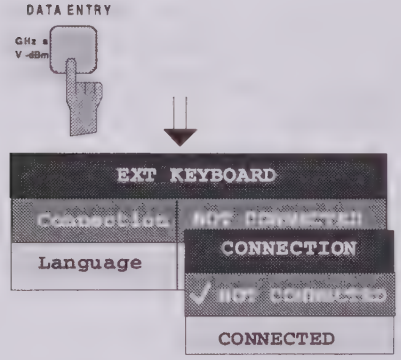




Setup keyboard connection

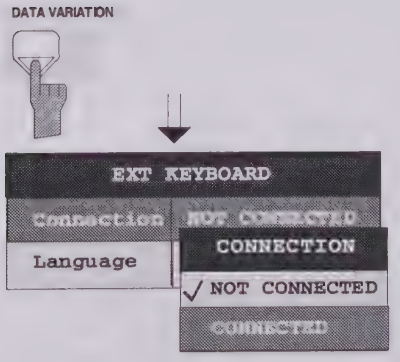
➢ Press the *EXTERNAL KEYBOARD* soft key.

The *CONNECTION* parameter in the *EXT KEYBOARD* table is marked by the selection bar.

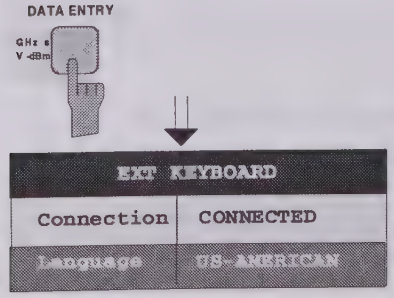


➢ Press one of the units keys.

The *CONNECTION* selection box appears on the display screen. The current state (NOT CONNECTED) is indicated by a check mark and the selection bar is in the background.

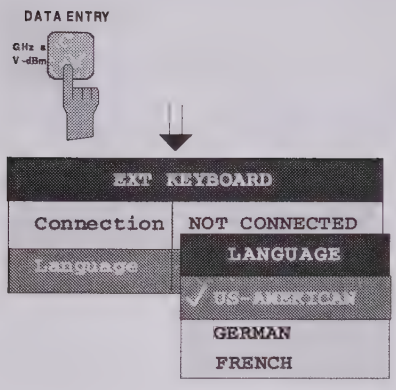


➢ Press the cursor key ⓤ until the *CONNECTED* entry is indicated by the selection bar.



➢ Press one of the units keys.

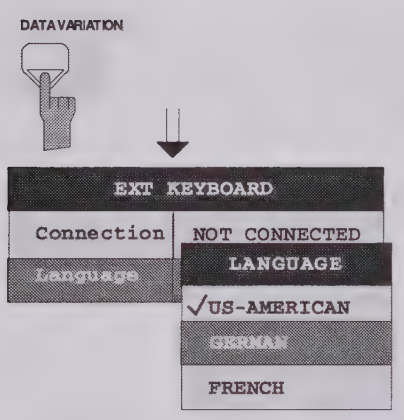
The *CONNECTION* selection box is closed, the setup *CONNECTED* is entered in the table, *EXT KEYBOARD* is entered and the selection bar is automatically set to the *LANGUAGE* parameter.



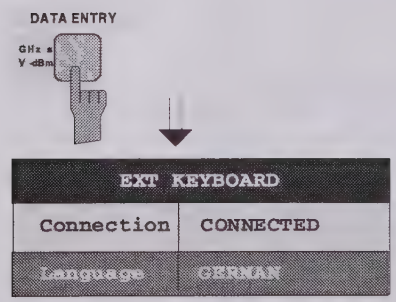
Select German keyboard

➢ Press one of the units keys.

The *LANGUAGE* selection box appears on the display screen. The current state is indicated by a check mark and the selection bar is in the background.



➢ Press the cursor key ⓘ until the *GERMAN entry* is indicated by the selection bar.



➢ Press one of the units keys.

The *LANGUAGE* selection box is closed and the *GERMAN* setting is entered in the *EXT KEYBOARD* table.

Note: *This setting is valid only for the measurement instrument mode. The keyboard assignment in DOS mode is independently set by using the corresponding MS-DOS command.*

Return to MAIN MENU

➢ Press the menu-change key several times.

1.6 Connecting an Output Device

Caution:
The output device may be connected only when the instrument is switched off (STANDBY)

The FSE provides an option for connecting up to four different output devices to allow printing a hard copy of the display screen. The output devices supported by the FSE can be found in the selection box *DEVICE/LANGUAGE* in the HARDCOPY –SETTINGS DEVICE1/2 menu (see in Chapter 2, the section "Documentation of Measurement Results").
Appendix A contains the interfeace description of the connectors.

The interface connectors are located on the rear panel (see Table 1.6-1).

Table 1.6-1 Interface Connectors for Output Devices

Rear panel interface connectors	LPT	COM1	COM2	<SCPI> IEC625
Name in instrument control	LPT1	COM1	COM2	GPIB1

After connection of the output device to the appropriate interface connector, the configuration of the interface as well as the output device must be entered and the output device must be assigned to the interface.

The configuration of the selected interface (COM1, COM2 or GPIB1) is performed according to the *SETUP-GENERAL SETUP* menu (key group: *CONFIGURATION*, see in Chapter 2, the section "Preliminary Setup and Interface Configuration").

Note: *Interface LPT cannot be configured. If the option FSE-B15, computer function, is installed, LPT1 can be used for printing in both the measurement instrument mode and the DOS mode. However, it can only be used for one mode at a time.*

Interfaces COM1 and COM2

- The parameters *COM PORTS BAUDRATE, BITS, PARITY, STOPBITS, HW/SW-HANDSHAKE* determine the transmission parameters of the interface.

  Note: *The transmission parameters must agree with the specifications of the output device (see the operating manual for the output device).*

- The parameter *COM PORTS PROTOCOL* informs the instrument that an output device is connected to an interface (REMOTE setting).

- The parameter *COM PORTS OWNER* assigns the interface to one or both operational modes.

  Note: *If printing is required in the measurement instrument mode, then this parameter must be set to INSTRUMENT or INSTRUMENT AND DOS. If, on the other hand, printing is required in DOS mode (Option FSE-B15, computer function), then the parameter must be set to DOS or INSTRUMENT AND DOS.*

Interface GPIB1

- The parameter *GPIB ADDRESS* passes the IEC Bus address of the output device to the instrument.

  Note: *If the output device is operated in "listen only" mode, this setup may be omitted.*

The configuration of the connected output device and the assignment to the interface takes place in the *HARDCOPY DEVICE–SETTINGS DEVICE1/2* menu (key group:*HARDCOPY*, see in Chapter 2, the section "Selection and Configuration of the Output Device "). The configuration of up to two output devices (DEVICE1 and DEVICE2) may be entered, of which, at least one must be activated for printing.

- The parameter *DEVICE/LANGUAGE* determines which output device is to be used.

  Note: *During the selection of the printer type, it must be observed that the selected printer type and the connected output device are compatible. In case of doubt, consult the operating manual for the output device.*

- The parameter *CONNECTION* sets the interface which is to be used.

The number of additional parameters which need to be entered depends upon the selected interface and the output device used.

- The parameter *ORIENTATION* sets the page format to horizontal or vertical (portrait).
- The parameter *DEVICE RESET* determines if the output device is to be reset before each print job.
- The parameter *FORMFEED* determines if a formfeed should follow each print job.
- The parameter *PAPER FEED* specifies the paper feeder (single sheet or endless paper).

Table 1.6-2 shows the standard factory settings for the two output devices.

The standard factory settings for *DEVICE 1* correspond to an output device controlled by the command language HPGL, typically, a plotter connected to the IEC-Bus interface.

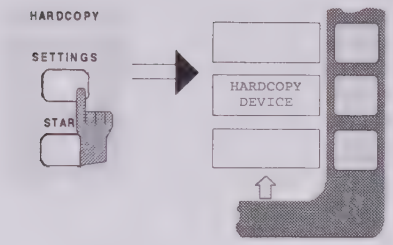
The standard factory settings for *DEVICE 2* correspond to a Epson printer (and compatible) connected to the parallel interface LPT.

Table 1.6-2 Factory settings for *DEVICE 1* and *DEVICE 2* in the *HARDCOPY-DEVICE SETTINGS* menu.

Parameter	**Parameter Name**	***DEVICE 1 Settings***	***DEVICE 2 Settings***
Output Device/Descriptive Language	DEVICE/LANGUAGE	HPGL	EPSON 24
Output Channel	CONNECTION	GPIB 1	LPT
IEC Bus Address	GPIB ADDRESS	4	---
Paper Format	ORIENTATION	PORTRAIT	PORTRAIT
Output Device Reset	DEVICE RESET	OFF	OFF
Formfeed	FORMFEED	OFF	ON
Paperfeed	PAPERFEED	MANUAL	MANUAL

In the following illustrative examples, a Postscript printer is connected to the LPT interface.

Note: *Interface LPT cannot be configured. The configuration of the other interfaces (COM1, COM2 or GPIB1) is performed according to the SETUP-GENERAL SETUP menu (key group: CONFIGURATION, see in Chapter 2, the section "Preliminary Setup and Interface Configuration").*



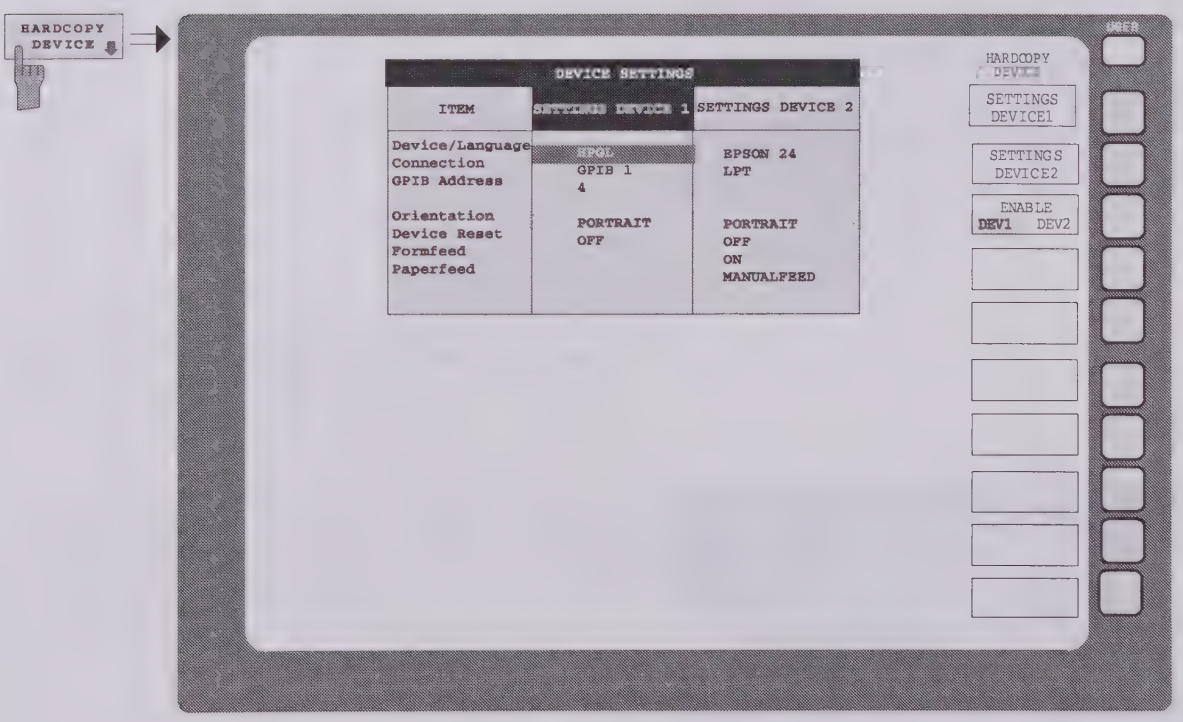
Configure printer and connect to interface

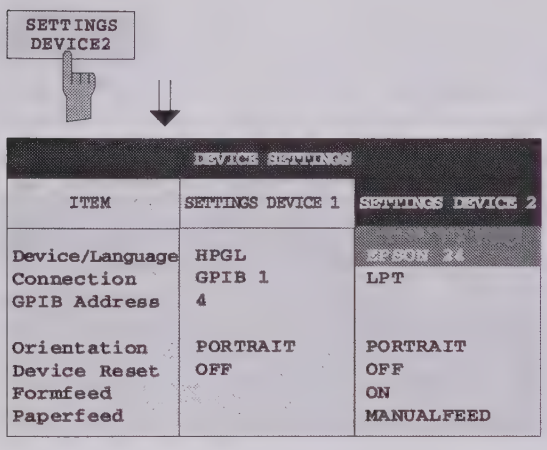
➢ Press the *SETTINGS* key of the *HARDCOPY* key group.

The *SETTINGS* menu is opened.

➢ Press the *HARDCOPY DEVICE* soft key

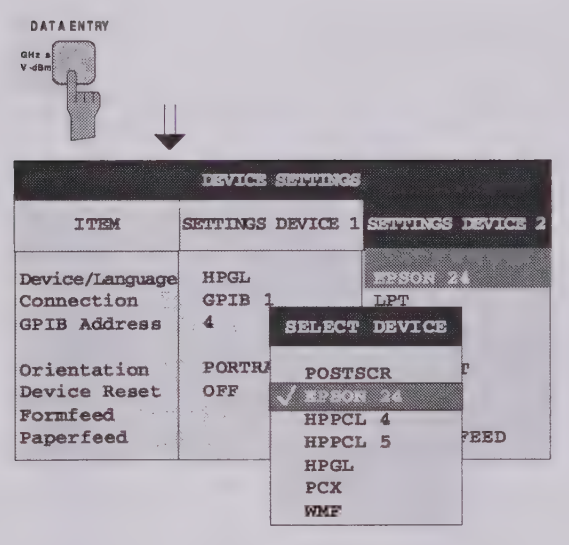
The *HARDCOPY DEVICE* sub-menu is opened and the current settings for the two possible output devices are displayed in tabular form on the display screen.





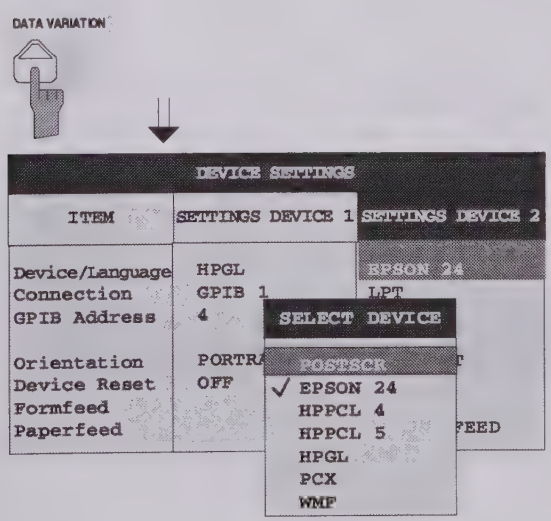
➢ Press the *SETTINGS DEVICE2* softkey.

The current selection in the first line of the table column *SETTINGS DEVICE2* is marked by the selection bar.

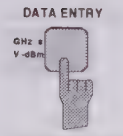


➢ Press one of the units keys.

The *SELECT DEVICE* selection box appears on the display screen. The current selection is indicated by a check mark and the selection bar is in the background.



➢ Press the cursor key ⓘ until the *POSTSCR* entry is indicated by the selection bar.



DEVICE SETTINGS

ITEM	SETTINGS DEVICE 1	SETTINGS DEVICE 2
Device/Language	HPGL	POSTSCR
Connection	GPIB 1	LPT
GPIB Address	4	
Orientation	PORTRAIT	PORTRAIT
Device Reset	OFF	OFF
Formfeed		ON
Paperfeed		MANUALFEED

➢ Press one of the units keys.

The *SELECT DEVICE* selection box is closed and the *POSTSCR* setting is entered in the table column *SETTINGS DEVICE2*. The selection bar now indicates the current entry in the next row of the table.

Note: *The CONNECTION parameter is set to LPT at the factory and, therefore, must not be changed. The selection of the printer type automatically sets the parameters ORIENTATION, DEVICE RESET, FORM FEED and PAPER LENGTH to values which correspond to a standard mode of operation with this output device.*

Activate printer

➢ Press the *ENABLE* soft key until DEV2 in the second soft key line is selected.

Return to main menu

➢ Press the menu-change key several times.

1.7 Firmware Update

The installation of a new firmware version can be performed using the built-in diskette drive and does not require opening the spectrum analyzer. The deliverable items contained in the Firmware Update Kit and the installation program call procedure may be found in the documentation accompanying the kit. The installation program then leads the user through the remaining steps of an update.
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1.8 Options

1.8.1 Option FSE-B17 – Second IEC/IEEE Interface

Besides the FSE external devices can also be controlled via the IEC/IEEE bus using the optional 2nd bus interface FSE-B17 and the computer function for FSE (option FSE-B15). The interface software permits IEC/IEEE-bus commands to be included in user programs.

1.8.1.1 Installing the software

1. The operating software is already installed and need not be loaded from the driver diskettes which serve as backup diskettes.
2. The driver GPIB.COM must be loaded on the start-up of DOS. For this to take place, the line DEVICE = C:\AT-GPIB\GPIB.COM has to be entered in the file C:\CONFIG.SYS. If the option is factory fitted, this line will have been entered in the factory.
3. The configuration of the card can be modified with the program C:\AT-GPIB\IBCONF.EXE. The following parameters may not be changed:

   ```
   Enable Auto Serial Polling .. No
   Base I/O Address ............ 02C0h
   Interrupt Level ............. NONE
   DMA Channel ................. 5
   ```

   For further parameters, refer to manual for the card.
4. The parameters of units connected are also set with the program IBCONF.EXE. The logic designation for FSE is preset to DEV1 and the address to 20. For further equipment refer to manual for the card.

   Note: *Ensure that the names assigned to the connected units are not the same as the directory names under DOS.*

1.8.1.2 Operation

The second IEC/IEEE-bus interface corresponds physically to that of FSE (see appendix A).
If the FSE is to be controlled via the IEC/IEEE bus, a bus cable must be plugged to both bus connectors.

The interface can be driven under DOS/WINDOWS by R&S software (FSE-K3, Order No. 1057.2996.02, etc.) or by user-written software. The handling of IEC/IEEE-bus commands in user programs is described in the manual for the card.

The files for DOS in the computer function are in directory C:\AT-GPIB, those for WINDOWS in directory C:\AT-GPIBW .

Note: *The program IBIC.EXE (see manual for the card) may not be used for controlling the FSE (measuring unit section); however external units can be controlled via the bus.*

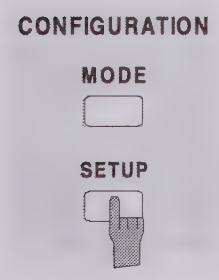
1.8.2 Option FSE-B5 - FFT Filter

Option FFT Filter FSE-B5 is a firmware option. It has to be enabled by a keyword.

1.8.2.1 Prerequisites

1. Keywords
   The keyword is printed on a label which is part of the equipment supplied and has to be stuck to the rear of FSE.
2. Hardware
   The modification state of module DIGITAL IF has to be either MODIF INDEX > 5 or MODIF INDEX = 5 and HW CODE ≥ 6. The modification state can be checked in the module list *INSTALLED COMPONENTS* in menu *INFO HARDWARE+OPTIONS*.
3. Firmware
   The modification state of the firmware has to ≥ 1.62. The modification state can be checked in table *FIRMWARE VERSION* in menu *INFO FIRMWARE VERSIONS*.

1.8.2.2 Enabling the option

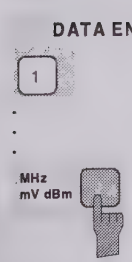


➢ Call up menu *SETUP* by pressing the *SETUP* key.

➢ Call up submenu *OPTIONS* by pressing the *OPTIONS* softkey.

Table *FIRMWARE OPTIONS* is displayed, listing the installed options.

➢ Activate the entry field by pressing the *ENABLE NEW OPTION* soft key.



➢ Enter the 10-digit keyword via the numeric keypad and terminate the entry by pressing one of the unit keys.

Now option FFT filter is listed in table *FIRMWARE OPTIONS*.

Note: *Message "option key invalid" indicates an invalid entry.*

1.8.3 Option FSE B16 – Ethernet Adapter

With the option Ethernet Adapter FSE-B16, the device can be connected to an Ethernet-LAN (local area network). Together with the option Computer Function FSE-B15 it is possible to transmit data via the network and to use the network printer. The adapter operates with a 10 MHz Ethernet in line with standards IEEE 802.3 10Base2 (Thin Ethernet, CheaperNet, BNC-Net) (B16 model 03) or 10Base5 (Thick Ethernet) (B16 model 02). Operation without the option Computer Function FSE-B15 is not possible.

1.8.3.1 Hardware Installation

Caution:
Prior to installation contact the network administrator, especially in case of complex LAN installations since mistakes in cabling might have influence the whole network.

If the adapter is installed at the factory, it is preconfigured. In case of retrofitting, refer to the installation instructions. The hardware settings must not be modified since the functions of the device could otherwise be impaired.

The following parameters are factory-set:

```
I/O Addr. 300,     IRQ 5,     MEM CA000
```

The connection with the network depends on the connectors used in the network.

1.8.3.1.1 BNC (Thin Ethernet, CheaperNet; FSE-B16 Var. 03)

Connection

The device is looped into the LAN segment via rear-panel 2 BNC connectors.
If a cable is not connected to one of the BNC connectors, this BNC connector has to be terminated with 50 Ohm. BNC T connectors must not be used.

Network traffic

Note that the network traffic is disturbed if a segment is interrupted.

Requirements

Thin Ethernet segment requirements have to be complied with:
- maximum segment length of 185 m
- minimum distance between the connectors of 0.5 m
- maximum of 30 connectors per segment.

If components that comply with enhanced requirements are exclusively used (Ethernet Adapter FSE-B16 complies with the enhanced requirements):
- maximum length of segment of 300 m
- maximum number of connectors of 100

With repeaters used:
- maximum total length of the network of 900 m containing a
- maximum of 3 segments
- maximum of two repeaters between two connectors

1.8.3.1.2 AUI (Thick Ethernet; FSE B16 Var. 02)

Connection

The device is connected to the LAN segment using a transceiver cable (DB-15 AUI connector, not part of the equipment supplied) which is connected to the rear panel and to the transceiver.

Network traffic

The connection does not conflict with the network traffic. The device can also be disconnected from the network without any problems but make sure that data are not being transmitted.

Requirements

The Thick Ethernet segment requirements have to be taken into account.
- The maximum segment length should be 500 m and the
- distance between the connectors should at least be 2.5 m.
- A maximum of 100 connectors may be used in a segment.

With repeaters used,
- the total length of the network must not be more than 2500 m containing
- a maximum of 3 segments.
- There should be no more than two repeaters between two connectors.

If other network components are used, these conditions may vary.

1.8.3.1.3 RJ45 (UTP, 10BaseT, Western Connector)

Connection

A direct connection to a RJ45 star topology is not possible. With a MINI transceiver (AUI → RJ45) used, connection can be made via the AUI port at the rear of the device.

Network traffic

This connection does not conflict with the network traffic. The device can also be disconnected from the network without any problems but make sure that data are not being transmitted.

Requirements

Since RJ45 is not a bus but a star topology no special requirements have to be taken into account for the connection.
The LAN requirements should be considered in the installation.

1.8.3.2 Software Installation

Data transmission within the network is by means of data blocks, the so-called packets. Besides user data other information, the so-called protocol data (transmitter, receiver, type of data, order) are transmitted. The drivers corresponding to the protocol have to be installed to process protocol information. A network operating system is required for network services (data transmission, directory services, printing in the network) and thus has to be installed.

1.8.3.2.1 Installation of Network Drivers

a) ODI

ODI drivers have been developed by NOVELL for the network operating system NETWARE. It is an open standard so that other systems can be based on it, too. The driver system is of modular design and can thus be easily adapted to the hardware.

Files required for installation:

```
LSL.COM        (ODI drivers)
SMC8000.EXE    (hardware drivers for the adapter)
NET.CFG        (configuration file)
```

The `NET.CFG` file comprises information required for the installation of the network drivers. It is a text file that can be generated by any editor e.g. EDIT.

At least the following information has to be contained in the `NET.CFG` file:

```
Link Support
      Max Stacks 8
      Buffer 12 1586
      MemPool 8192

Link Driver SMC8000
      Port 300
      Mem  CA000
      Int  5
      Frame ETHERNET_II
```

Parameter `Frame ...` depends on the type of packets used in the network. The network administrator can provide information about the frame type used. With a wrong type used, problems will not occur in the network but a connection to other systems cannot be set up.

Loading the drivers

The drivers have to be loaded under DOS in the following order:

```
LSL

SMC8000
```

To allow for an automatic start, the drivers can be entered into the `C:\NETWORK.BAT` file. This batch file will be executed automatically when the device is started. The drivers can be unloaded if the programs are called up with the parameter `/U`. Unloading has to be in the reverse order.

b) NDIS

NDIS drivers are mainly used by network operating systems from MICROSOFT (DOS MS-NET,WINDOWS FOR WORKGROUPS, WINDOWS 95, WINDOWS NT). It is an open system so that other systems can be based on it, too. The driver system is of modular design and can thus be easily adapted to the hardware.

Files required for installation:

```
PROTMAN.DOS
PROTMAN.EXE
NET.EXE
NET.MSG
IFSHLP.SYS
PROTOCOL.INI
NDISHLP.SYS
NETH.MSG
WFWSYS.CFG
SMC8000.DOS     (Hardware drivers for the adapter)
SYSTEM.INI
```

Files `PROTOCOL.INI` and `SYSTEM.INI` contain information required for installing the network drivers. They are text files that can be created or modified by any editor, e.g. EDIT.

At least the following information has to be contained in the `PROTOCOL.INI` file:

```
[network.setup]
version=0x3110
netcard=ms$w8003e,1,MS$W8003E,3
transport=ms$nwlinknb,NWLINK
transport=ms$ndishlp,MS$NDISHLP
transport=ms$netbeui,NETBEUI
lana0=ms$w8003e,1,ms$nwlinknb
lana1=ms$w8003e,1,ms$ndishlp
lana2=ms$w8003e,1,ms$netbeui

[protman]
DriverName=PROTMAN$
PRIORITY=MS$NDISHLP

[NWLINK]

BINDINGS=MS$W8003E
[MS$NDISHLP]
DriverName=ndishlp$
BINDINGS=MS$W8003E

[NETBEUI]
DriverName=netbeui$
SESSIONS=10
NCBS=12
BINDINGS=MS$W8003E
LANABASE=1

[MS$W8003E]
DriverName=SMC8000$
irq=5
iobase=0x300
ramaddress=0xca00

[SMC8000W]
Adapters=MS$W8003E
```

At least the following information has to be contained in the SYSTEM.INI file:

```
[Network]
winnet=wfwnet/00025100
multinet=nonet
FileSharing=Yes
PrintSharing=Yes
LogonDisconnected=yes
EnableSharing=Yes
UserName=FSE
Workgroup=WORKGROUP
ComputerName=FSE
Comment=fse
[network drivers]
netcard=smcmac.dos
transport=ndishlp.sys,*netbeui
devdir=C:\NDIS
LoadRMDrivers=No

[NWNBLINK]
LANABASE=0
```

Parameter "UserName= ..."	comprises the user name for the network.
Parameter "Workgroup= ..."	comprises the user name for the network.
Parameter "ComputerName= ..."	determines the name of the device in the network. This name has to be unique in the network.

All drivers should be copied into a directory, e.g. C:\NDIS.

Requirements in the CONFIG.SYS file

The C:\CONFIG.SYS file has to be extended by the following line:

```
DRIVER = C:\NDIS\IFSHLP.SYS
```

To do this, the read-only attribute of the file has to be removed by the following DOS command:

```
ATTRIB C:\CONFIG.SYS -R
```

Loading the drivers

On startup of the device, the network drivers will be loaded automatically.

c) Packet Drivers

The "Packet" network driver system has been developed by universities and can be used free of charge. Many free-of-charge network operating systems (KERMIT) are based on this driver system. Although the drivers for these network cards used to be made at universities, manufacturers have now started to supply their own drivers.

File required for installation:

```
PKT8000.COM
```

Loading the drivers

The driver should be copied into a directory, e.g. `C:\PACKET`.

The DOS command

```
C:\PACKET\PKT8000 -i 0x7e 5 0x300 0xca00
```

starts the driver.

To allow for an automatic start, the driver can be entered into the `C:\NETWORK.BAT` file. This batch file will be executed automatically on the startup of the device.

1.8.3.2.2 Installation of Network Operating System

a) NOVELL NETWARE

ODI drivers are the precondition for NOVELL NETWARE. The access software is available in three models: NETWARE SHELL, NETWARE REQUESTER and NETWARE CLIENT 32. NETWARE SHELL allows access to NETWARE 3 servers only. The NETWARE REQUESTER allows access to NETWARE 3 as well as NETWARE 4 (NDS). NETWARE CLIENT 32 cannot run on the device.

NETWARE SHELL

Files required for installation:

```
IPXODI.COM

NETX.EXE
```

The files should be copied into the directory comprising the network drivers.

If a connection to a certain network server is requested, the name of the server can be entered into the `NET.CFG` file by means of the following line:

```
PREFERRED SERVER = FSESERVER
```

(FSESERVER has to be replaced by the server name in the network).

Loading the drivers

The drivers are loaded under DOS in the following order:

```
IPXODI

NETX
```

To allow for an automatic start, the drivers can be entered into the `C:\NETWORK.BAT` file in addition to the network drivers. This batch file will be executed automatically on the startup of the device. The drivers can be unloaded if the programs are called up with the parameter `/U` . Unloading has to be in the reverse order.

NETWARE REQUESTER

Files required for installation:

```
IPXODI.COM
AUTO.VLM
BIND.VLM
CONN.VLM
FIO.VLM
GENERAL.VLM
IPXNCP.VLM
NDS.VLM
NETX.VLM
NMR.VLM
NWP.VLM
PNW.VLM
PRINT.VLM
REDIR.VLM
RSA.VLM
SECURITY.VLM
TRAN.VLM
VLM.EXE
```

The files should be copied into the directory comprising the network drivers.

Changes in the `CONFIG.SYS` file

In the `C:\CONFIG.SYS` file line

```
LASTDRIVE = V:
```

has to be replaced by line

```
LASTDRIVE = Z:
```

To do this, the read-only attribute of the file has to be removed with the DOS command

```
ATTRIB C:\CONFIG.SYS -R
```

Changes in the `NET.CFG` file

The `NET.CFG` file is extended by the following lines:

```
Netware Dos Requester
     NETWARE PROTOCOL = NDS  BIND
     FIRST NETWORK DRIVE = W
     SHOW DOTS = ON
     SPX CONNECTIONS = 99
     IPX PACKET SIZE LIMIT = 1514
     hold= off
```

If a connection to a certain network server is requested, the name of the server can be entered into the NET.CFG file by means of line

```
PREFERRED SERVER = FSESERVER
```

(FSESERVER has to be replaced by the server name in the network).

Loading the drivers

The drivers are loaded under DOS in the following order:

```
IPXODI
VLM
```

To allow for an automatic start, the drivers can be entered into the `C:\NETWORK.BAT` file in addition to the network drivers. This batch file will be executed automatically on the startup of the device. The drivers can be unloaded if the programs are called up with the parameter `/U`. Unloading has to be in the reverse order.

b) MICROSOFT NET

Drivers required

The NDIS drivers are the precondition for the MICROSOFT NET. Other drivers are not required.

Loading the drivers

The start is via the following DOS command:

```
C:\NDIS\NET START
```

To allow for an automatic start, the command can be entered into the `C:\NETWORK.BAT` file. This batch will be executed automatically on the startup of the device.

c) TCP/IP

TCP/IP (Transmission Control Protocol / Internet Protocol) is not a network operating system but a standard. This standard allows to transmit data between computers using different operating systems. The services are managed by utility programs such as FTP, TELNET, KERMIT, HTTP, RSH. TCP/IP only provides services for the transport and network addressing.

Drivers required

TCP/IP can be based on the ODI or PACKET drivers. Normally, another driver providing the TCP/IP support is required. See corresponding product about the use of the drivers.

d) KERMIT

Drivers required

The data transmission program KERMIT is based on the PACKET drivers. To install KERMIT it is required to copy all the files into a directory, e.g. `C:\KERMIT`. The precondition for this is that an IP address is assigned to the device by the network administrator and that the Sub Net Mask for the network is known. Both addresses are in the form of four digits from 0 to 255 separated by a dot. An IP address in the network has to be unique as problems might otherwise occur. The Sub Net Mask is the same in the whole network.

Examples of IP address: `89.0.0.14`

Example of Sub Net Mask: `255.255.0.0`

1.8.3.3 Operation

After installing the network operating system it is possible to transfer data between the device and other computers and to use printers in the network. A precondition for network operation is the authorization to use network resources. Resources may be access to the file directories of other computers or the use of a central printer. The network or server administrator will grant the authorizations. The network name of the resource and the corresponding authorization are required. Passwords protect the resources against improper use. A user name is normally assigned to every authorized user. The user also has a password. Resources may then be assigned to the user. The type of access, i.e. whether data are only read or also written as well as a shared access to data has to be defined. Other types are possible depending on the network operating system.

1.8.3.3.1 NOVELL

Operating system NETWARE from NOVELL is as server-supported system. Data transfer between the individual workstations is not possible. Data transfer is between workstation computers and a central computer, the server. This server provides storage capacity and the connection to the network printers. Like under DOS, the data on a server are organized in directories and are offered to the workstation as virtual drives. A virtual drive on a workstation is like a hard disk and data can be processed accordingly. This is called drive mapping. Also network printers can be addressed as normal printers. Network operating system NOVELL is available in two forms: NETWARE 3 and NETWARE 4 NDS. In the previous version NETWARE 3, each server manages its own resources itself and is independent. A user has to be managed separately on each server. For NOVELL 4 NDS, all resources are managed in the NDS (NOVELL DIRECTORY SERVICE). The user only has to log in once and gains access to the resources released for him. The individual resources and the user are managed as objects in a hierarchical tree (NDS TREE). The position of the object in the tree is called CONTEXT for NETWARE and must be known in order to access the resources.

Logging into network

After all network drivers have been loaded and the device has established a connection with the server, a new drive `W:` is generated. After a change to this drive, the log in can be started with the

```
LOGIN
```

command. The user name and the password are queried.

For NOVELL 4 NDS it is necessary to set the CONTEXT beforehand using the

```
CX <context>
```

command.

Virtual drives

To generate a virtual drive on the computer function of a device, the following command is used

```
MAP [ROOT]<dr>:=<server>/,<volume>:<directory>
```

where:

dr	drive indicator under which the virtual drive is addressed (E to P, R to V)
server	name of the NOVELL server on which the directory is located.
volume	name of the data medium on which the directory is located.
directory	name of the directory which is to be accessed.

If parameter ROOT is specified, the higher directories can no longer be addressed.

Example:

```
MAP P:=VENUS/SYS:MESURE\FSE
```

causes that the directory \MESURE\FSE on hard disk SYS of server VENUS appears on the device as drive P . In drive P it is also possible to see the directory structure of MESURE. If the command is called up with the parameter ROOT, it would only be possible to access directory structures below FSE.

The

```
MAP DEL <lw>:
```

command allows drive mapping to be canceled.

Storage of device data on a server

Instead of storing device data on hard disks, they can be stored on virtual drives. To do this, it is first required to generate a virtual drive E: in the computer function. The LOADINFO file in directory d:\ has to comprise line

```
ATTACHDEVICE E_DOS AS :C: EDOS
```

to enable the device to recognize the drive. Access to E: is according to normal device functions.

Printing on a network printer

To be able to use a printer in the computer function, this printer has to be connected first with the computer function by means of the following command

```
CAPTURE L=<lpt> Q=<printer_queue>
```

where:

lpt	printer port (1=LPT1, 2=LPT2, 3=LPT3)
printer_queue	name of printer queue.

Example:

```
CAPTURE L=1 Q=PRINTER_FSE
```

causes printer data which are normally sent to printer port LPT1 to be routed to the network printer called PRINTER_FSE.

Hardcopy from device to a network printer

It is not possible to directly route a hardcopy from the device to a network printer. It has to be printed first into a file on the hard disk (Print to File). This file is then copied to the printer in the computer function.

This procedure is automated by the following DOS batch file:

```
START:
IF NOT EXIST C:\USER\OUTPUT.PRN GOTO START
COPY C:\USER\OUTPUT.PRN LPT1 /B
DEL C:\USER\OUTPUT.PRN
GOTO START
```

If this batch program is called up, the computer function waits until the device has generated a print file called OUTPUT.PRN, prints this file and deletes it again.

1.8.3.3.2 MICROSOFT

For MICROSOFT, data can be transferred between workstations (peer-to-peer) but also between workstations and servers. The servers can provide access to individual files as well as the connection to network printers. Like under DOS, the data on a server are organized in directories and are offered to the workstation as virtual drives. A virtual drive on a workstation is like a hard disk and data can be processed accordingly. This is called drive mapping. Also network printers can be addressed as normal printers. A connection to DOS, WINDOWS FOR WORKGROUPS, WINDOWS95, WINDOWS NT is possible.

Logging into network

After all network drivers are loaded and the device has established a connection with the server, a new drive W: is generated. After a change to this drive, the log in can be started with the

```
NET LOGON
```

command. The user name and the password are queried.

Virtual Drives

To generate a virtual drive on the computer function of a device, the following command is used

```
NET USE <dr>: \\<server>\<verzeichnis>
```

where:

dr	drive indicator under which the virtual drive is addressed (E to P, R to V)
server	name of the server on which the directory is located.
directory	name of the directory which is to be accessed.

Example:

```
NET USE P: VENUS\MESSUNG\FSE
```

causes the directory \MESURE\FSE of server VENUS to appear as drive P on the device.

Drive mapping is canceled by means of

```
NET USE <lw>: \\<server>\<directory> /DELETE
```

Storage of device data on a server

Instead of storing device data on hard disks, they can be stored on virtual drives. To do this, it is first required to generate a virtual drive E: in the computer function. The LOADINFO file in directory `d:\` has to comprise line

```
ATTACHDEVICE E_DOS AS :C: EDOS
```

to enable the device to recognize the drive. Access to `E:` is according to normal device functions.

Printing on a network printer

To be able to use a printer in the computer function, this printer has to be connected first with the computer function by means of the following command

```
NET USE <port>: \\<server>\<printerqueue>
```

port	printer port (LPT1, LPT2, LPT3)
server	name of server on which the directory is located
printerqueue	name of printer queue of printer

Example:

```
NET USE LPT1: \\VENUS\PRINTER_FSE
```

uses printer data which are normally sent to printer port LPT1 to be routed to the network printer called PRINTER_FSE.

Hardcopy from device to a network printer

It is not possible to directly route a hardcopy from the device to a network printer. It has to be printed first into a file on the hard disk (Print to File). This file is then copied to the printer in the computer function.
This procedure is automated by the following DOS batch file:

```
START:
IF NOT EXIST C:\USER\OUTPUT.PRN GOTO START
COPY C:\USER\OUTPUT.PRN LPT1 /B
DEL C:\USER\OUTPUT.PRN
GOTO START
```

If this batch program is called up, the computer function waits until the device has generated a print file called OUTPUT.PRN, prints this file and deletes it again.

1.8.3.3.3 TCP/IP

The TCP/IP protocol allows files to be transmitted between different computer systems. A program running on both computers is required to control the data transfer. The same operating or file system need not be used by the two partners. A file transfer is possible between DOS/WINDOWS and UNIX, for example. One partner has to be configured as host the other as client or vice versa. The system performing several processes at the same time (UNIX) will normally be the host. The usual file transfer program used for TCP/IP is FTP (File Transfer Protocol). An FTP host is installed as standard on most of the UNIX systems.

Columbia University provides the KERMIT program which not only allows file transfer via networks but also via modem. KERMIT can be used free of charge. The two procedures provide safe data transmission, i.e. errors normally do not occur.

1.8.3.3.4 FTP

For a complete description of the functions and commands see the FTP documentation.

Establishing a connection

The program is started with the DOS command

```
FTP
```

The following command sets up the connection:

```
OPEN <xx.xx.xx.xx>
```

xx.xx.xx.xx = IP address, e.g. 89.0.0.13

File transmission

To transmit a file to the target system, the following command is used:

```
PUT <file name>
```

file name = name of file e.g. DATA.TXT.

To call a file from the target system, the following command is used:

```
GET<file name>
```

file name = name of file e.g. SETTING.DAT.

```
TYPE B
```

allows the transmission of files in the BINARY format, no conversion is performed.

```
TYPE A
```

allows the transmission of files in the ASCII format. Thus, control characters are converted so that the text files can be read on the target system, too.

Examples:

```
PUT C:\AUTOEXEC.BAT
```

sends the `AUTOEXEC.BAT` file to the target system.

```
LCD DATA
```

changes to subdirectory DATA in the computer function.

```
CD SETTING
```

changes to the subdirectory SETTING on the target system.

Changing directories

The command

```
LCD <path>
```

changes the directory as the corresponding DOS command.

```
LDIR
```

lists the directory.

These commands refer to the computer function of the instrument. If the 'L' preceding the commands is omitted, they apply to the target system.

1.8.3.3.5 KERMIT

KERMIT comprises a large number of functions described in detail in the help file KERMIT.HLP.

Establishing a connection

The program is started by means of the DOS command

```
KERMIT
```

The

```
SET TCP/IP ADDRESS <xx.xx.xx.xx>
```

xx.xx.xx.xx = IP address e.g. 89.0.0.13

command allows to set the individual IP address.

The Sub Net Mask is set by means of

```
SET TCP/IP SUBNETMASK <xx.xx.xx.xx>
```

xx.xx.xx.xx= Sub Net Mask e.g. 255.0.0.0.

These commands can also be entered into the `MSCUSTOM.INI` file and will be executed automatically when KERMIT is started.

The computer to which data are to be transferred is set by means of

```
SET PORT TCP/IP <xx.xx.xx.xx>
```

xx.xx.xx.xx=IP address of target computer.

A prerequisite is that the KERMIT program on the target computer is running in the host mode.

KERMIT can be ordered via Internet in WWW (URL: http://WWW.COLUMBIA.EDU) from COLUMBIA UNIVERSITY for almost all operating systems.

The

```
CONNECT
```

command sets up the connection.

The

```
HANGUP
```

command allows to stop the connection and the

```
QUIT
```

command to leave the program.

Data transmission

To transmit a file to the target system, the

```
SEND <file name>
```

```
file name = name of file e.g. DATA.TXT
```

command is used. To transmit a file from the target system, the

```
GET<file name>
```

```
file name = name of file e.g. SETTING.DAT
```

command is used.

Changing directories

Like with DOS, the directory is changed by means of the

```
CD <path>
```

command and the contents of the directory is indicated by means of the

```
DIRECTORY
```

command.

These commands concern the computer function of the device. If `REMOTE..` is used in front of the commands, they apply to the target system.

Examples:

```
SEND C:\AUTOEXEC.BAT
```

sends the `AUTOEXEC.BAT` file to the target system.

```
CD DATA
```

changes to the subdirectory DATA in the computer function.

```
REMOTE CD SETTING
```

changes to the subdirectory `SETTING` on the target system.

2 Manual Operation

Chapter 2 describes the manual operation of the instrument. It includes section 2.1 "Measurement Examples", Section 2.2, "Menu Overview", and section 2.3 "Basic Operation", allowing to get familiar with FSE operation.
Starting from section 2.4, the complete functions of the FSE are described in detail.

2.1 Measurement Examples

This section describes a typical, simple measurement task for a spectrum analyzer. In the following description, each step is explained in detail using the FSE so that the instrument can be immediately used without the need for learning all of the available functions. The described measurement applications are:

- Measurement of the level and frequency of a sine wave signal.
- Measurement of harmonics.
- Measurement of third order intermodulation and determination of the intercept point.
- Zero span measurement of a pulsed signal.

All of the following examples assume the standard settings for the analyzer. These are set with the *PRESET* key in the *SYSTEM* key field. The most important standard settings are shown in Table 2.1-1. A complete listing of standard settings can be found in Chapter 2.4.

Table 2.1-1 Important PRESET settings

Parameter	Parameter name	Setting			
		FSEA	FSEB	FSEM	FSEK
Mode	Mode	analyzer	analyzer	analyzer	analyzer
Center frequency	Center Frequency	1,75 GHz	3,5 GHz	13,25 GHz	20 GHz
Active Freq. Meas. Range	Span	3,5 GHz	7 GHz	26,5 GHz	40 GHz
Reference Level	Ref Level	– 20 dBm	– 20 dBm	– 20 dBm	– 20 dBm
RF Attenuation	RF ATT	10 dB	10 dB	10 dB	10 dB
Level Display Range	Level Range	100 dB	100 dB	100 dB	100 dB
Resolution Bandwidth	Res Bw	3 MHz	3 MHz	3 MHz	3 MHz
Video Bandwidth	Video Bw	3 MHz	3 MHz	3 MHz	3 MHz
Sweep Time	Sweep Time	5 ms	5 ms	150 ms	225 ms
Trigger	Trigger	free run	free run	free run	free run

2.1.1 Level and Frequency Measurements

2.1.1.1 Measurement Task

The determination of the level and frequency of a signal is one of the most frequently encountered measurement tasks typically performed by a spectrum analyzer. Usually, for the measurement of an unknown signal, the PRESET settings are initially selected. If levels above +30 dBm are expected or possible, then a power attenuator must be inserted ahead of the analyzer input. Without attenuation, these signal levels might damage or destroy the input attenuator or the input mixer.

2.1.1.2 Important Spectrum Analyzer Functions

Important parameters for level and frequency measurements are the settings for the *CENTER FREQUENCY*, the selection of the active measurement frequency range (*SPAN*) and the *MARKER* functions.

2.1.1.3 Sweep, Level and Frequency Measurements – Example 1

In this example, a signal with a frequency of 200 MHz and a level of -10 dBm are applied to the RF INPUT of the analyzer. The selection of the center frequency and the active frequency range takes place manually.
The necessary setup functions are performed almost without exception by the fixed-function keys. The menus which appear with a key can, for the most part, be ignored. In this manner, fast, key-oriented operation is possible.

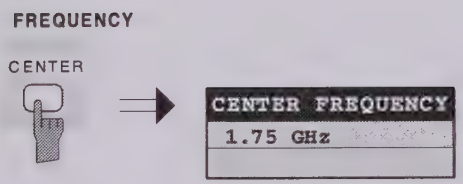
The following setup steps are performed:

1. Reset the instrument.
2. Apply the test signal.
3. Set the center frequency to 200 MHz.
4. Reduce the active measurement frequency range (SPAN) to 1 MHz.
5. Measure the level and frequency using the marker.
6. Optimize the measurement dynamic range and reduce the level measurement error.
7. Measure the frequency with the internal frequency counter

1. Reset the instrument.

➢ Press the *PRESET* key.

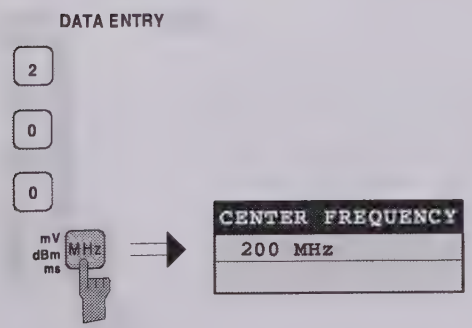
2. Connect the test signal to the RF INPUT located on the instrument front panel.



3. Set the center frequency to 200 MHz.

➢ Press the *CENTER* key in the *FREQUENCY* key field.

The input field for center frequency appears on the display screen.



➢ Enter *200* via the numeric keypad and terminate with the *MHz* key.

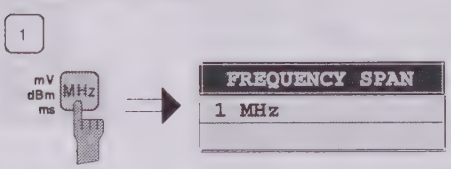
FREQUENCY

SPAN

4. *Reduce the measurement frequency range (SPAN) to 1 MHz.*

➢ Press the *SPAN* key in the *FREQUENCY* key field.

DATA ENTRY



➢ Enter *1* via the numeric keypad and terminate with the *MHz* key.

Note: *In conjunction with the change in measurement frequency range (SPAN), the resolution bandwidth (RES BW), video bandwidth (VIDEO BW) and sweep time (SWEEP TIME) are set to new values since they are defined as coupled functions in the standard PRESET settings.*

MARKER

NORMAL

5. *Measure level and frequency using the marker and read the resulting values on the display screen.*

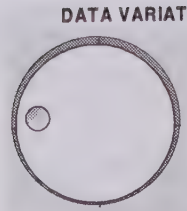
➢ Press the *NORMAL* key in the *MARKER* key field.

The marker jumps to the largest signal peak shown on the display screen.

Note: *When the marker is switched on for the first time, it automatically performs the PEAK SEARCH function as demonstrated in this example.*
If a marker was already active, the SEARCH key in the MARKER key field must be pressed in order to set the currently active marker to the displayed signal maximum.

The level and frequency measured by the marker can be read in the marker field at the upper edge of the display screen. (see Figure 2.1-1).

DATA VARIATION



➢ Using the roll-key, the marker can be moved along the measured curve.

The corresponding level and frequency values appear in the marker field.

Figure 2.1-1 shows the measured curve on the display screen over a 1 MHz range as well as the marker level and frequency values.

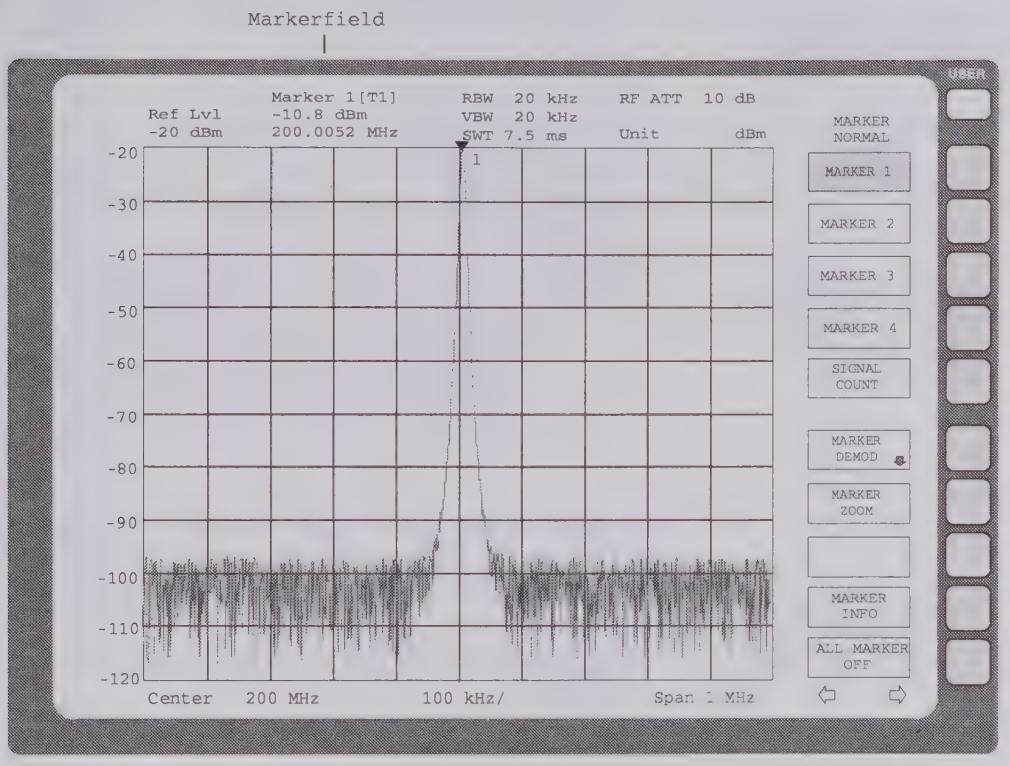
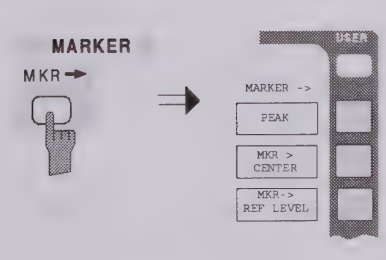


Fig. 2.1-1 200-MHz signal. The measured values are displayed in the marker field.

At low signal-to-noise ratios, the level measurement accuracy can be improved by an optimum selection of the FSE parameters. The accuracy of the frequency display can also be enhanced by applying the internal frequency counter.



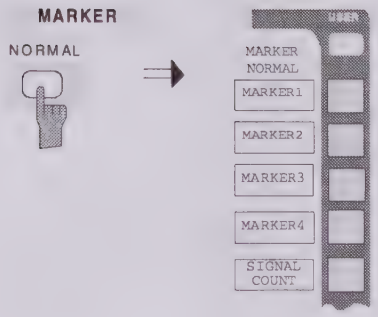
6. Optimize the dynamic range and reduce the level measurement error.

➢ Press the *MKR→* key in the *MARKER* key field.

The *MARKER-MKR→* menu is opened.

➢ Press *MKR → REF LEVEL* soft key.

The reference level (REF LEVEL) is reduced to the signal level.

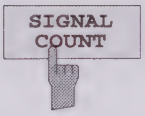


7: Determine the exact frequency with the internal frequency counter.

Note: *The frequency counter measures the frequency of the marked signal with the selected counter resolution and at the accuracy of the internal frequency reference. A frequency measurement made using the marker is, however, limited by the number of horizontal display points and the applicable resolution bandwidth.*

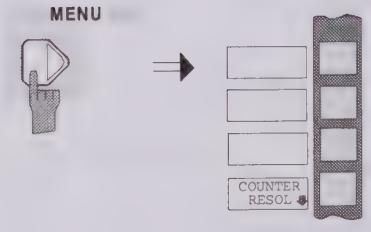
➢ Press the *NORMAL* key in the *MARKER* key field.

The *MARKER NORMAL* menu is opened.



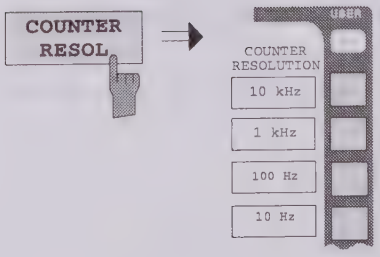
➢ Press the *SIGNAL COUNT* soft key.

The internal frequency counter is now active and measures the signal frequency with the PRESET resolution. The resolution is to be increased to 10 Hz.



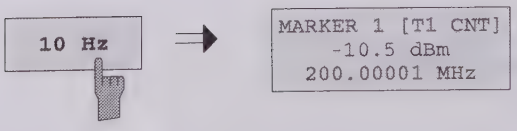
➢ Press the menu change key .

The supplementary menu is opened.



➢ Press the *COUNTER RESOL* soft key.

The *COUNTER RESOLUTION* sub-menu is opened.



➢ Press the *10 Hz* soft key.

The desired frequency resolution (10 Hz) is now selected.

In the marker field, the item [CNT] indicates that the counter is active (see Fig. 2.1-2).

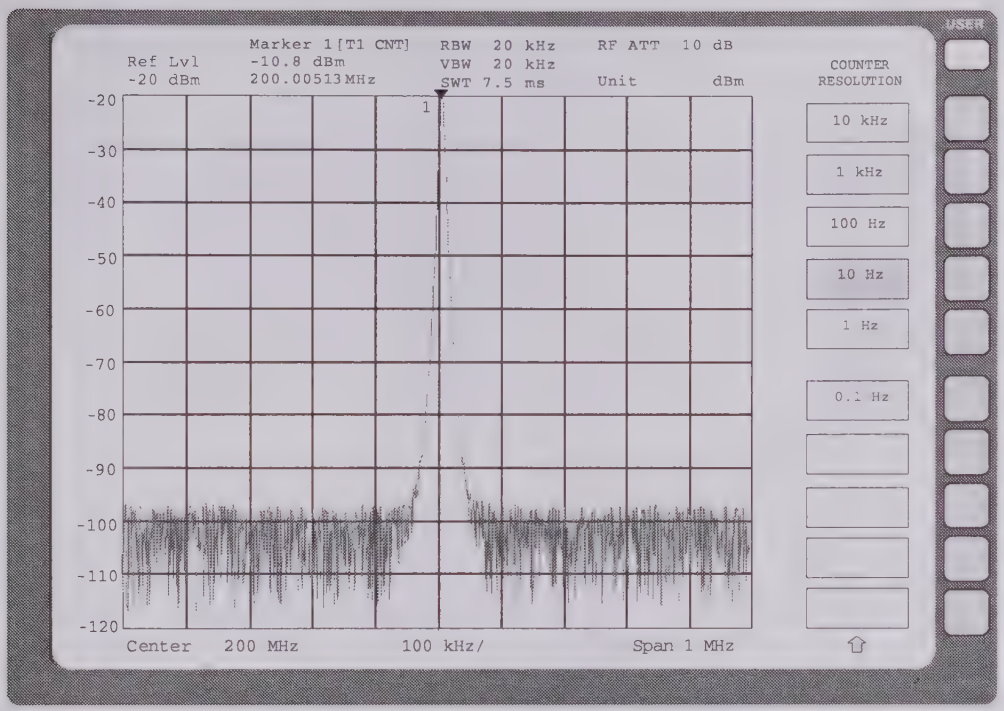


Figure 2.1-2 Frequency measurement using the internal frequency counter.

2.1.1.4 Sweep, Level and Frequency Measurements – Example 2

The zoom function (*MARKER ZOOM*) operates much faster than the manual input of center frequency and measurement frequency range, and permits the measurement frequency range displayed on the screen to be as narrow as desired.

As in Example 1, a signal with a frequency of 200 MHz and a level of -10 dBm is applied to the analyzer RF INPUT.

The following setup steps are performed:

1. Reset the instrument.
2. Apply the signal.
3. Zoom in on the signal.
4. Measure the level and frequency with the marker.
5. Optimize the dynamic range and reduce the level measurement error.
6. Measure the frequency with the internal frequency counter.

Steps 1 to 2 and 4 to 6 correspond to steps 1 to 2 and 5 to 7, respectively, of Example 1. Step 3 replaces the manual input of center frequency and measurement frequency range. (steps 3 and 4).

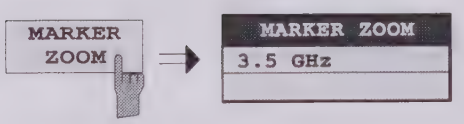
See steps 1 and 2 of example 1

1. ***Reset the instrument to standard settings.***
2. ***Connect the test signal to the analyzer RF INPUT.***

3. ***Zoom in on the signal.***

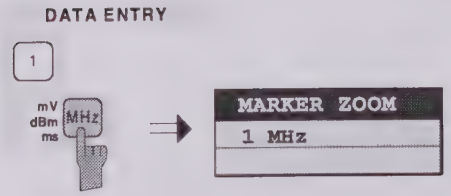
➢ Press the *NORMAL* key in the *MARKER key field* .

The marker moves to the largest signal displayed on the screen. In this example, it is the signal at 200 MHz. (PEAK SEARCH function, see step 5 in Example 1).



➢ Press the *MARKER ZOOM* soft key.

The input field for the measurement frequency range appears on the display screen.



➢ Enter 1 via the numeric keypad and terminate with the *MHz* key.

After entry of the measurement frequency range, the marked signal is counted and then used as the new center frequency. At the same time, the entered measurement frequency range is set.

Note: *In conjunction with the active measurement frequency range (SPAN) change, the resolution bandwidth (RES BW), video bandwidth (VIDEO BW) and sweep time (SWEEP TIME) are also set to new values since they are defined as coupled functions in the standard PRESET settings.*

See steps 5 to 7 of example 1:

4. ***Read the values for level and frequency as measured by the marker.***
5. ***Optimize the dynamic range and reduce the level measurement error.***
6. ***Determine the frequency with the internal frequency counter.***

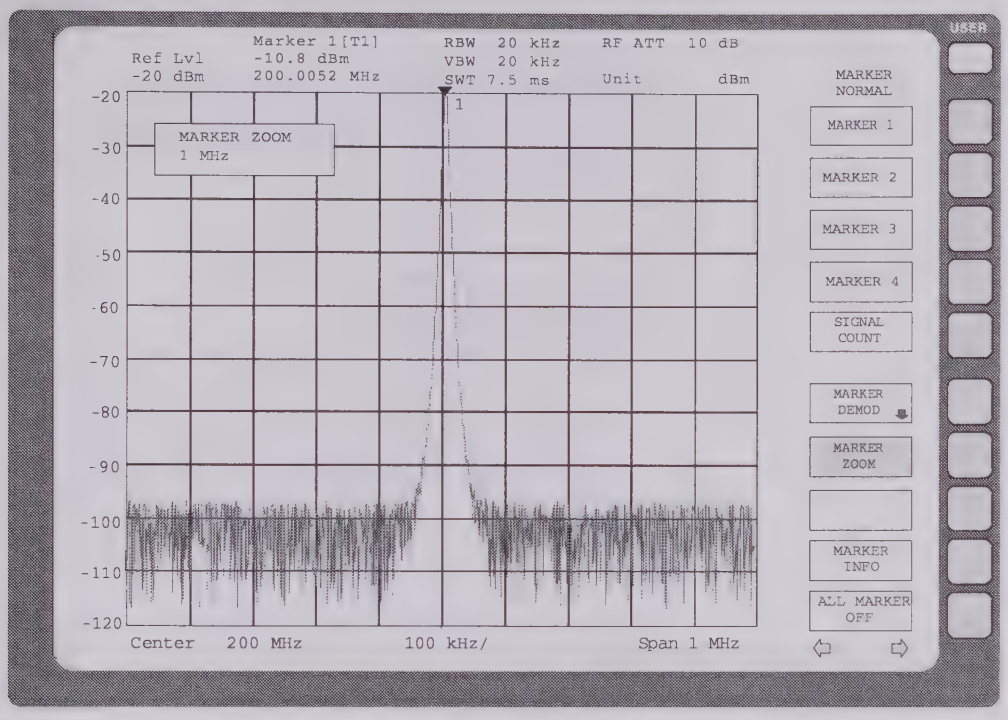


Figure 2.1-3 The The MARKER ZOOM function requires the entry of the measurement frequency range (span)

2.1.1.5 Level Measurement Accuracy

The level measurement accuracy of an analyzer is influenced by the following parameters:

- RF attenuator (*RF-ATT*)
- IF amplification
- Resolution bandwidth (*RES BW*)
- Display range (*LEVEL RANGE*)
- Display linearity (*SCALE FIDELITY*)

The error in a level measurement for the FSE is < 1 dB for frequencies up to 1 GHz and < 1.5 dB for frequencies from 1 GHz to 3.5 GHz. This specification includes all of the above mentioned influential factors. The frequency characteristics of the pertinent modules (RF divider, front end) are stored individually in memory on each module. The FSE initializing routines read out the corresponding values during execution immediately after the analyzer is turned on and corrects the frequency characteristics during the sweep. Any errors in the attenuation settings, the filter bandwidth or the video rectifier are corrected after calling the built-in calibration routines. For calibration purposes, the FSE has an internal 120 MHz calibration source which is switched internally to the RF INPUT.
The measurement accuracy is guaranteed only after running the calibration routines. It should be noted, however, that the individual parameters are so stable that a calibration need only be performed, after approximately 15 minutes warm-up time, for larger temperature variations. Normally, a weekly calibration is more than adequate.

2.1.2 Measurement of Harmonic Separation

2.1.2.1 Measurement Task

The measurement of signal harmonics is a frequently occurring task which can be optimally performed by a spectrum analyzer. In general, all signals will contain harmonics to some degree. Harmonics are especially critical in high-power transmitters, e.g., in radio transmitters, where a significant radiated harmonic component may interfere with the reception of other radio services. Generally, non-linear device characteristics create harmonics which are often selectively reduced through the use of low-pass filters. Since the spectrum analyzer also has non-linear characteristics, e.g., at the first mixer, it is necessary to exercise caution during a measurement to insure that the spurious harmonics generated by the analyzer do not influence the measurement results. If necessary, the fundamental frequency must be selectively attenuated with respect to the harmonics by insertion of an appropriate high-pass filter.

For harmonic-content measurements, the achievable measurement dynamic range is dependent upon the k2 intercept of the spectrum analyzer. The k2 intercept point is defined as the fictitious first-mixer input level where the levels of the first harmonic and of the fundamental frequency are equal. In practice, this level cannot be applied to the mixer since, to do so, would cause its destruction. However, using the k2 intercept point concept, the achievable measurement dynamic range for the harmonics of a Unit Under Test (UUT) can be calculated with relative simplicity.

As can be seen in Fig. 2.1-4, the harmonic level is reduced by 20 dB when the level at the fundamental frequency is reduced by 10 dB.

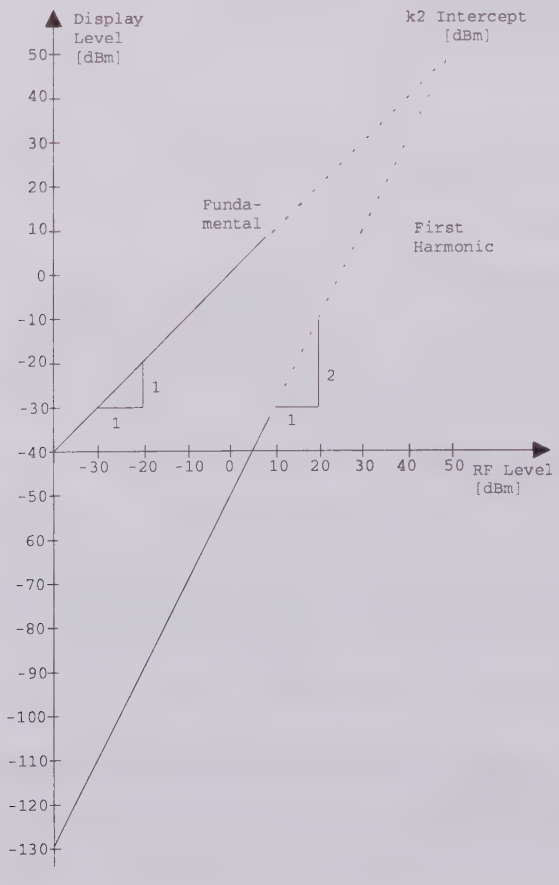


Figure 2.1-4 Theoretical display curve of fundamental and first harmonic with a k2 intercept of 50 dBm.

From the linear equations and the given intercept point, the following formula can be derived for the achievable harmonic separation a_{k2} in dB:

$$a_{k2} = IP2 - P_e \qquad (1)$$

a_{k2} = harmonic separation
P_e = mixer level/dBm
IP2 = k2 intercept point

The formula for the internally produced level P_1 at the first harmonic in dBm is:

$$P_1 = 2 \bullet P_e - IP2 \qquad (2)$$

The lower harmonic measurement limit is dictated by the noise figure of the spectrum analyzer. Through adequate averaging with the video filter, the UUT harmonic level which is to be measured should be at least 4 dB over the noise figure so that the measurement error caused by the input noise is less than 1 dB.

From the above, the following rules for the measurement of large harmonic separations can be derived:

- Select an IF bandwidth as narrow as possible in order to reduce the noise figure.
- Select the RF attenuation as high as required so that the necessary harmonic separation can still be measured.

Note: *The mixer amplitude is the applied RF level reduced by the selected RF attenuation. The low distortion (LOW DISTORTION function) mode of the analyzer automatically sets the optimum RF attenuation for the best harmonic separation.*

The maximum harmonic separation is achieved when the harmonics level is equal to the inherent noise level of the receiver. The corresponding level at the mixer according to (2) is:

$$P_e[dBm] = \frac{P_{noise} / dBm + IP2}{2}$$

For a 30 Hz resolution bandwidth, (noise level < -140 dB, IP2 = 50 dBm), this level is -45 dBm. Therefore, according to (1) , the maximum measurable harmonic separation is 95 dB less 4 dB minimum signal-to-noise ratio.

2.1.2.2 Important Spectrum Analyzer Functions

In addition to frequency and level settings, the harmonic separation measurement requires, above all, the delta markers. Also, the MRK→ CF STEP SIZE function (marker frequency = center frequency step-width) is used in order to quickly measure the individual harmonics with the cursor keys.

There are several methods to measure harmonic content:

- The measurement of fundamental and harmonic signals in one measurement frequency range.
- The individual measurement of the harmonic separation in a narrow measurement frequency range. This method is preferred when high harmonic separation is to be measured (requires large dynamic range and, thus, narrow resolution bandwidth) or the frequency of the fundamental is very high, i.e., a very wide measurement frequency range is necessary.
- The measurement of fundamental and harmonics in two independent windows on the display screen (SPLIT SCREEN mode).

Example 1 describes the measurement of fundamental and harmonics in one measurement frequency range.

Example 2 describes the measurement of harmonic separation in separate measurement frequency ranges.

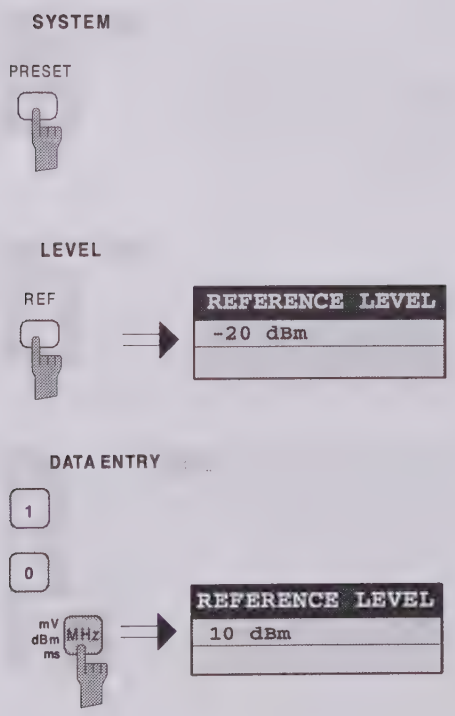
Example 3 shows the measurement of fundamental and harmonics in two independent windows on the display screen.

2.1.2.3 Measurement Procedure - Harmonic Separation – Example 1

The analyzer 10 MHz reference signal is used at the input signal. The connector EXT REF IN/OUT on the rear panel is connected to the analyzer front-panel RF INPUT. Since the output level is 7 dBm, the reference level must be set to 10 dBm.

The following setup steps are performed:

1. Reset the instrument.
2. Set the reference level to 10 dBm.
3. Connect the rear-panel 10 MHz reference signal to the analyzer input RF INPUT.
4. Set the start frequency to 5 MHz.
5. Set the stop frequency to 55 MHz.
6. Smooth the displayed noise with the video bandwidth.
7. Measure the fundamental signal with the marker.
8. Measure the harmonic separation with the delta marker.
9. Measure the separation of remaining harmonics.



1. Reset the analyzer.

➢ Press the *PRESET key*.

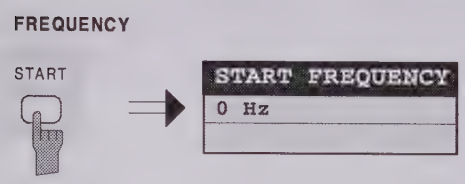
2. Set the reference level to 10 dBm.

➢ Press *REF* key in the *LEVEL* key field.

The entry field for the reference level appears on the display screen.

➢ Enter 10 via the numeric keypad and terminate with the *dBm* key.

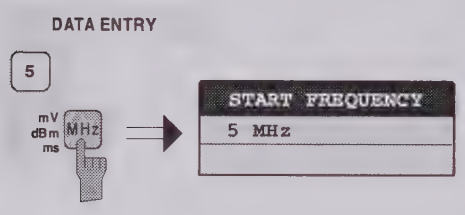
3. Connect the 10 MHz-reference signal (output EXT REF IN/OUT) to the analyzer RF INPUT.



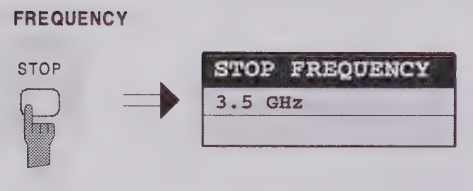
4. Set the start frequency to 5 MHz

➢ Press the *START* key in the *FREQUENCY* key field.

The entry window for the start frequency appears on the display screen.



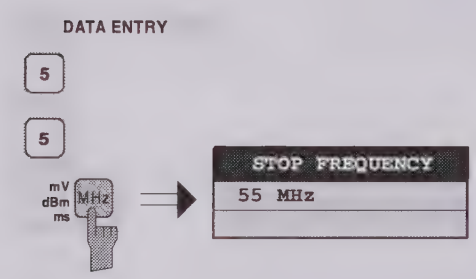
➢ Enter 5 via the numeric keypad and terminate with the *MHz* key.



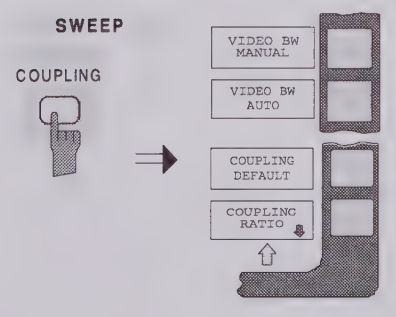
5. Set the stop frequency to 55 MHz

➢ Press the *STOP* key in the *FREQUENCY* key field.

The entry window for the stop frequency appears on the display screen.



➢ Enter 55 via the numeric keypad and terminate with the *MHz* key.

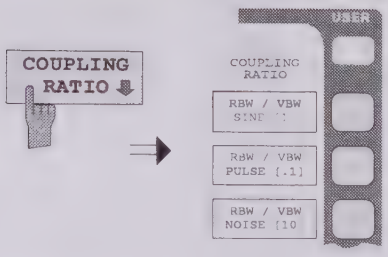


6. Smooth the displayed noise with the video bandwidth

➢ Press the *COUPLING* key in the *SWEEP* key field.

The *SWEEP-COUPLING* menu is opened.

The video bandwidth can now be either automatically coupled to the resolution bandwidth or manually entered.

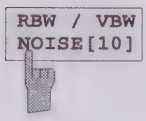


either:

Automatic coupling of the video bandwidth to the measurement frequency range

➢ Press the *COUPLING RATIO* soft key.

The sub-menu for setting the automatic coupling of bandwidths to the measurement frequency range is opened.



➢ Press the *RBW / VBW NOISE* soft key *[10]*.

The video bandwidth is set to a factor of 10 less than the resolution bandwidth. This smoothes the displayed noise.

➢ Press the menu change key .

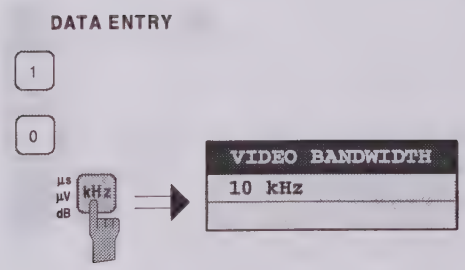
The *COUPLING RATIO* submenu is closed.

or:

Manual input of the video bandwidth

➢ Press the *VIDEO BW MANUAL soft key.*

The entry field for the video bandwidth appears on the display screen.



➢ Enter 10 via the numeric keypad and terminate with the *kHz* key.

The analyzer displays the fundamental as well as the first to third harmonics (see Fig. 2.1-5).

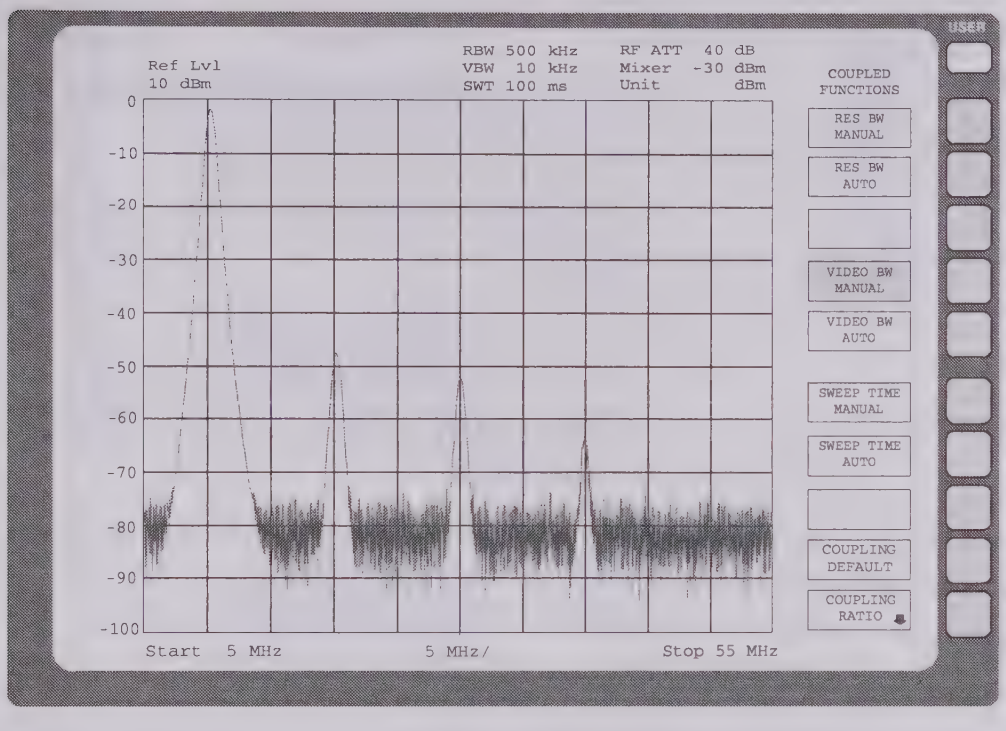


Figure 2.1-5 The 10-MHz-fundamental and harmonics to 55 MHz

7. Measure the fundamental with the marker.

➢ Press the *NORMAL* key in *MARKER* key field.

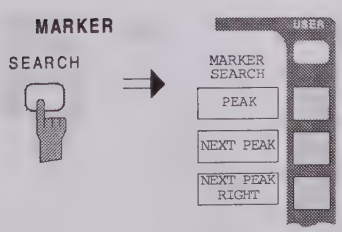
The marker appears at the fundamental peak (see also level and frequency measurement step 5 of the PEAK SEARCH function).

The measured values can be read at the upper left of the display screen.

8: Activate the delta marker and measure the harmonic separation

➢ Press the *DELTA* key in the *MARKER* key field

The delta marker is active and appears on the fundamental.



➢ Press the *SEARCH* key in the *MARKER* key group .

The *SEARCH-MARKER* menu is opened.

➢ Press the *NEXT PEAK RIGHT* soft key.

The delta marker jumps to the first harmonic and measures the difference between the harmonic and the fundamental. The measured values can be read at the upper left of the display screen. In this example, the harmonic separation is approx. 40 dB (see Fig. 2.1-6).

9. Measure the separation of additional harmonics

➢ Press the *NEXT PEAK RIGHT* soft key.

The delta marker jumps to the next highest harmonic. The measured value can be read as before.

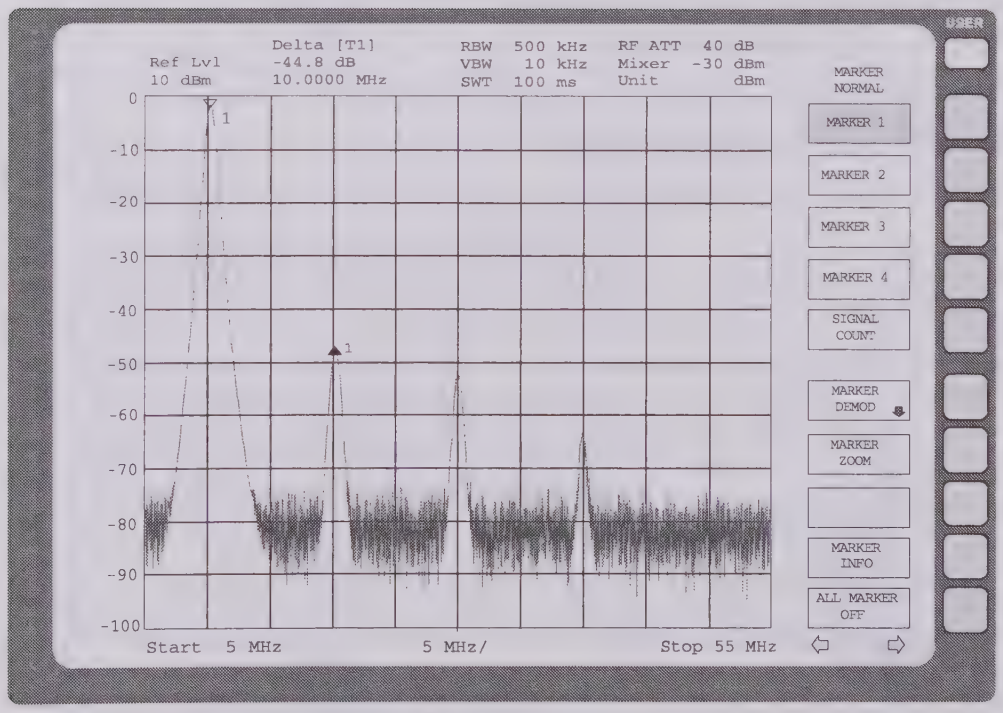


Figure 2.1-6 First harmonic separation: approx. 40 dB referred to the fundamental

2.1.2.4 Measurement Procedure - Harmonic Separation – Example 2

In example 2, the fundamental frequency of the test signal and the separation of the individual harmonics are measured. The reference to the fundamental is established with the REFERENCE FIXED marker, and the movement from harmonic to harmonic is performed with the MKR→ CF STEP SIZE and step keys. This method is recommended when the highest dynamic range is to be achieved.

The following measurement steps are carried out:

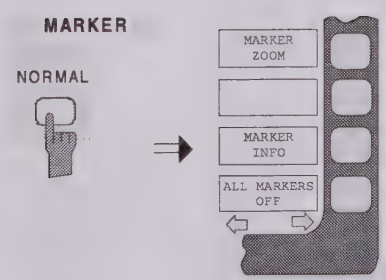
1. Reset the instrument.
2. Set the reference level to 10 dBm.
3. Connect the rear-panel 10 MHz reference signal (connector EXT REF IN/OUT) to the analyzer input RF INPUT.
4. Set the start frequency to 5 MHz.
5. Set the stop frequency to 55 MHz.
6. Smooth the displayed noise with the video bandwidth.
7. Measure the fundamental signal with the marker.
8. Reduce the measurement frequency range (ZOOM function):
9. Set the frequency step size to the fundamental frequency.
10. Save the reference value (REFERENCE FIXED)
11. Measure the separation to the first harmonic.
12. Measure the separations to the remaining harmonics.

Set the analyzer according to Example 1 up to and including "Measure the fundamental with the marker" (steps 1 to 7).

8. Reduce the measurement frequency range.

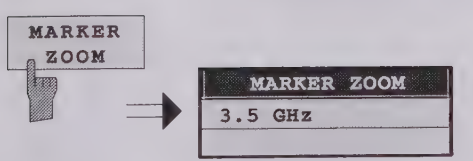
➢ Press the *NORMAL* key in the *MARKER key field* .

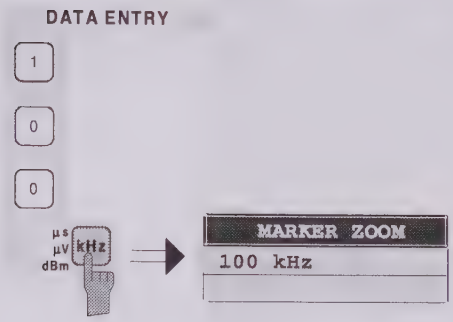
The *MARKER-NORMAL* menu is opened.



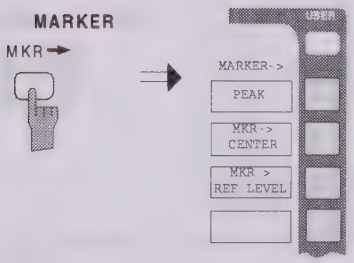
➢ Press the *MARKER ZOOM* soft key.

The entry field for the measurement frequency range appears on the display screen.





➢ Enter 100 via the numeric keypad and terminate with the *kHz* key.



9. Set the frequency step size to the fundamental frequency

➢ Press the *MKR →* key in the *MARKER* key field

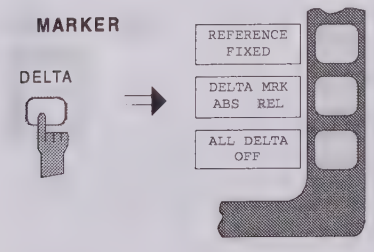
The *MARKER-MKR →* menu is opened.

➢ Press the *PEAK* soft key.

The marker appears at peak of the fundamental signal.

➢ Press the *MKR → CF STEP SIZE* soft key.

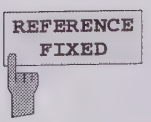
The step size used when setting the center frequency with the cursor keys is set equal to the marker frequency.



10. Fix reference value

➢ Press the *DELTA* key in the *MARKER* key field.

The *DELTA-MARKER* menu is opened.



➢ Press the *REFERENCE FIXED* soft key.

The position of the marker is now a curve-independent reference for the delta measurement, even when the actual reference point is not visible on the display screen.

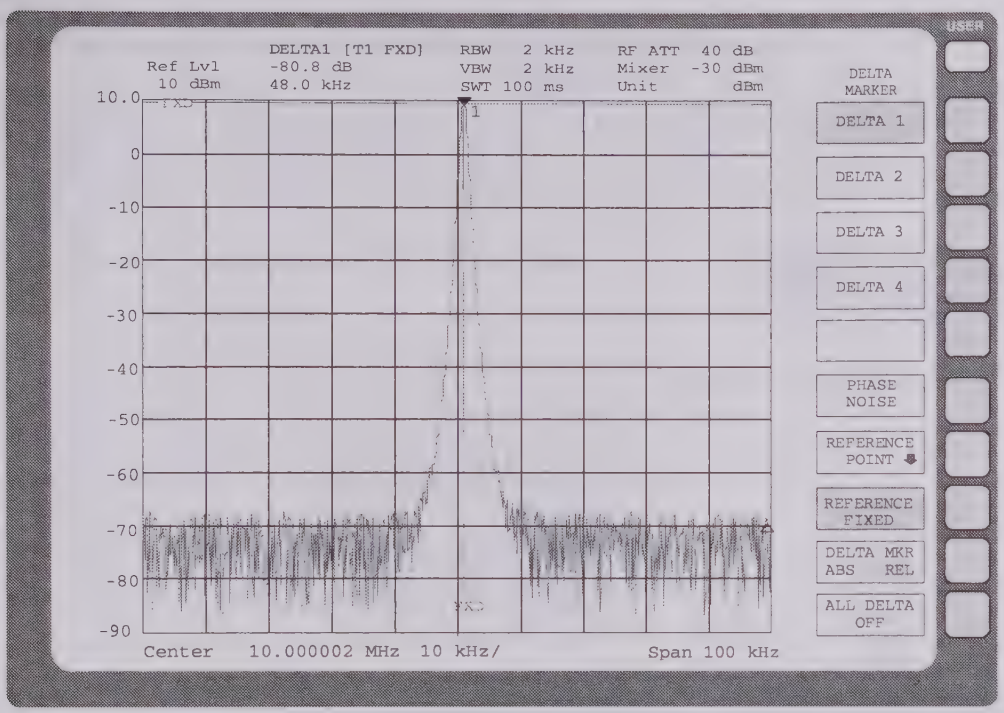
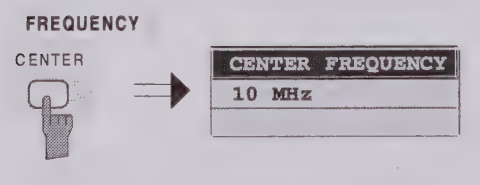


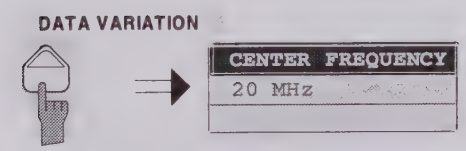
Figure 2.1-7 Fundamental with REFERENCE FIXED marker



11. Measure the harmonic

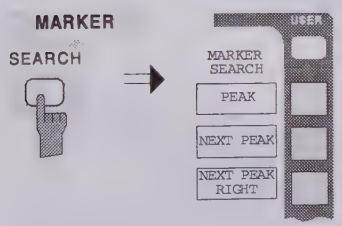
➢ Press the *CENTER* key in the *FREQUENCY* key field.

The entry field for the center frequency appears on the display screen.



➢ Press the cursor key in the *DATA VARIATION* key field.

The center frequency is increased by one step (= fundamental frequency).



➢ Press the *SEARCH* key in the *MARKER* key field.

The *SEARCH-MARKER* menu is opened.

➢ Press the *PEAK* softkey.

The delta marker appears at the first harmonic and measures the separation from harmonic to fundamental. The measured value is displayed in the marker field at the upper left of the display screen (see Fig. 2.1-8).

12. Measure the separation of additional harmonics

➢ Repeat all of step 11.

The center frequency is once again increased by the frequency of the fundamental. The delta marker thus appears at the next harmonic.

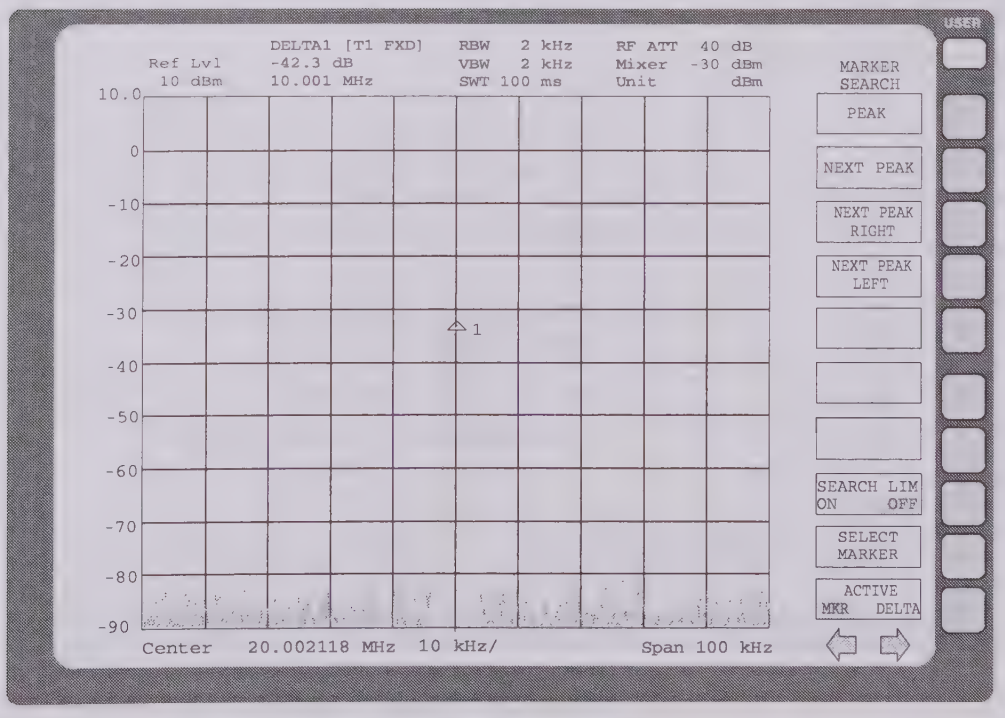


Figure 2.1-8 Measurement of the first harmonic

Note: *The spurious harmonics generated internal to the analyzer can be easily recognised by switching in additional RF attenuation. When an additional 10 dB attenuation is inserted, the displayed level of harmonics generated by the analyzer will be reduced by 10 dB, however, harmonics from the UUT will remain unchanged. This assumes that the receiver noise is substantially below the displayed level.*

2.1.2.5 Measurement Procedure - Harmonic Separation – Example 3

The measurement of fundamental and harmonics can also be performed in two independent windows on the display screen (SPLIT-SCREEN mode). This mode permits the simultaneous presentation of the fundamental and harmonics with higher resolution and dynamic range.

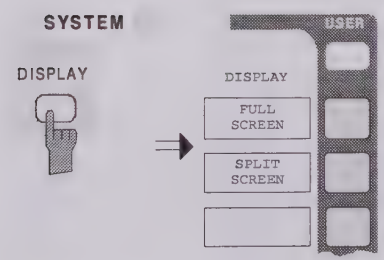
The following measurement steps are carried out:

1. Reset the instrument.
2. Set the reference level to 10 dBm.
3. Connect the rear-panel 10 MHz reference signal (connector EXT REF IN/OUT) to the analyzer input RF INPUT.
4. Set the start frequency to 5 MHz.
5. Set the stop frequency to 55 MHz.
6. Smooth the displayed noise with the video bandwidth.
7. Measure the fundamental signal with the marker.
8. Reduce the measurement frequency range (ZOOM function):
9. Set the frequency step size to the fundamental frequency.
10. Set the display to two measurement windows.
11. Uncouple the window settings.
12. Measure the harmonic separation.

Set the analyzer according to Example 2 up to and including " Set the frequency step size to the fundamental frequency" (steps 1 to 9).

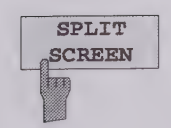
---

10. Set the display to two uncoupled measurement windows.



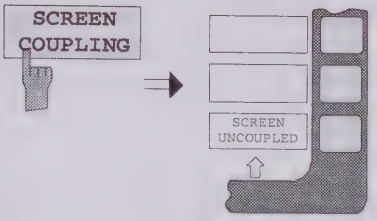
➢ Press the *DISPLAY* key in the *SYSTEM* key field.

The *SYSTEM DISPLAY* menu is opened.



➢ Press the *SPLIT SCREEN* soft key.

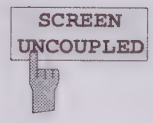
Two windows are displayed simultaneously on the display screen (see Fig. 2.1-9). The upper measurement window is called Screen A and the lower is called Screen B. At the initial turn-on, both measurement windows are coupled, i.e., changes in settings such as frequency or levels take place in both windows.



11. Uncouple the window settings

➢ Press the *SCREEN COUPLING* soft key.

The *SCREEN COUPLING* sub-menu is opened.



➢ Press the *SCREEN UNCOUPLED* soft key .

The settings for each measurement window can now be selected independently. The entry is assigned to either *ACTIVE SCREEN A* or *ACTIVE SCREEN B* as selected by the soft key in the main menu window.

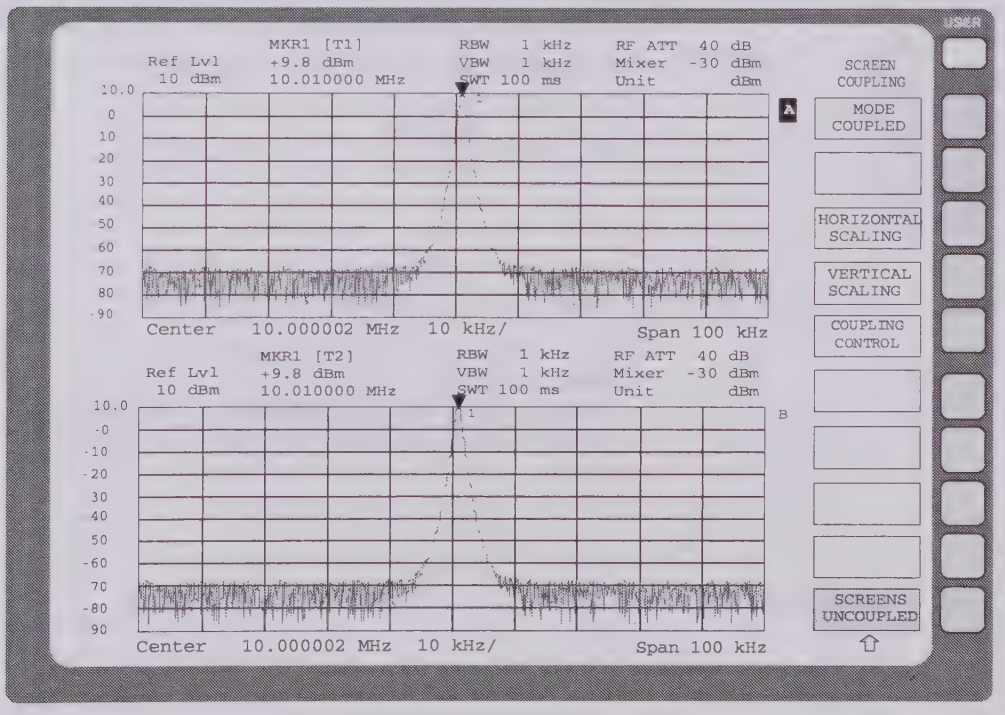
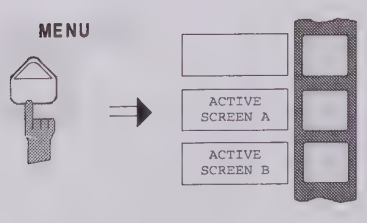


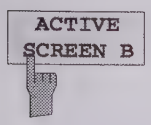
Figure 2.1-9 SPLIT-SCREEN Mode

12. Measure the harmonic in the lower measurement window SCREEN B.

➢ Press the menu change key .

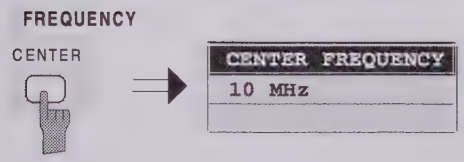
The main menu is opened.





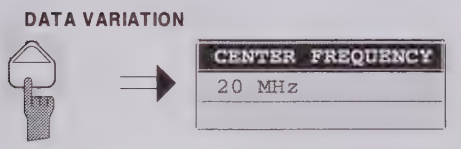
➢ Press the *ACTIVE SCREEN B* soft key.

The following entries are now valid for the lower window which is used to measure the harmonic separation.



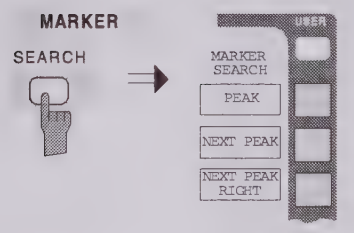
➢ Press the *CENTER* key in the *FREQUENCY* key field.

The entry field for the center frequency appears on the display screen.



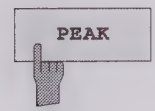
➢ Press the cursor key in the *DATA VARIATION* key field.

The center frequency is increased by one step. (= fundamental frequency).



➢ Press the *SEARCH* key in the *MARKER* key field.

The *SEARCH-MARKER* menu is opened.



➢ Press the *PEAK* soft key.

A marker appears at the first harmonic and measures the level of the harmonic. The measured value is displayed in the marker field at the upper left of the second measurement window (see Fig. 2.1-10).

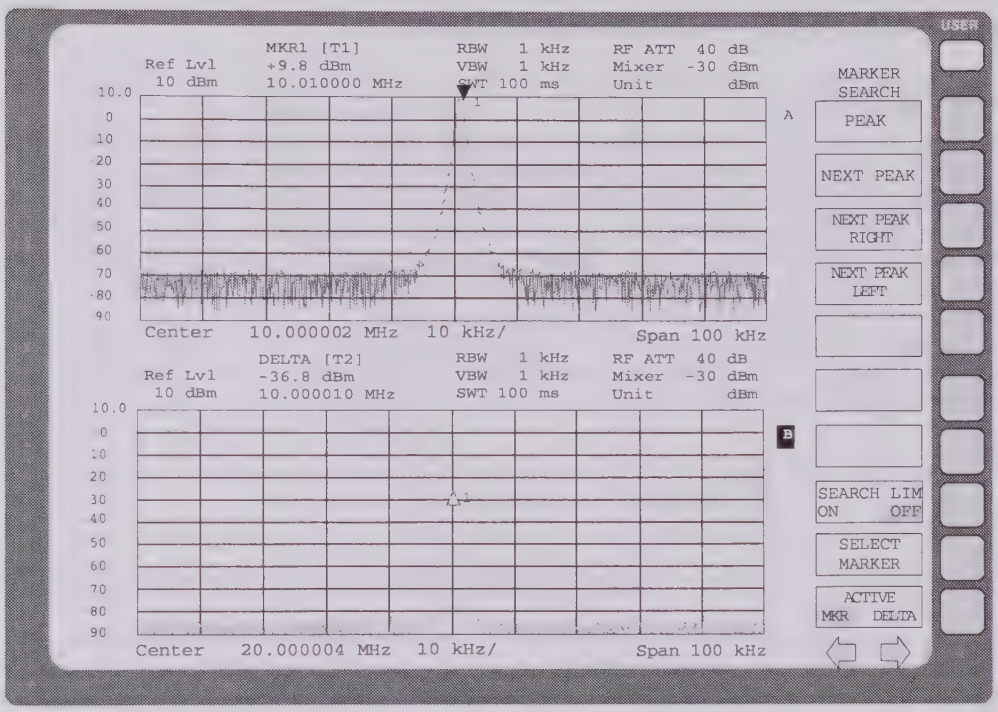


Figure 2.1-10 Alternate representation of fundamental and first harmonic

2.1.3 Measurement of Intermodulation Distortions

2.1.3.1 Measuring Task

If several signals are applied to a transmission quadripole with a non-linear characteristic, intermodulation products occur at its output due to addition and subtraction of the signals. The non-linear characteristic causes harmonics of the information signals to occur, which are mixed up at the characteristic. The low-order mixture products are particularly significant since they have the highest levels and are close to the information signals. The third-order intermodulation product causes the most significant distortions. In case of two-tone modulation it is the mixture product of the first information signal and the first harmonic of the second information signal.
The frequencies of the spurious signals occur with an offset of the information signals above and below the information signals. Figure 2.1-11 shows the intermodulation products P_{S1} and P_{S2}, which are obtained from the two information signals P_{N1} and P_{N2}.

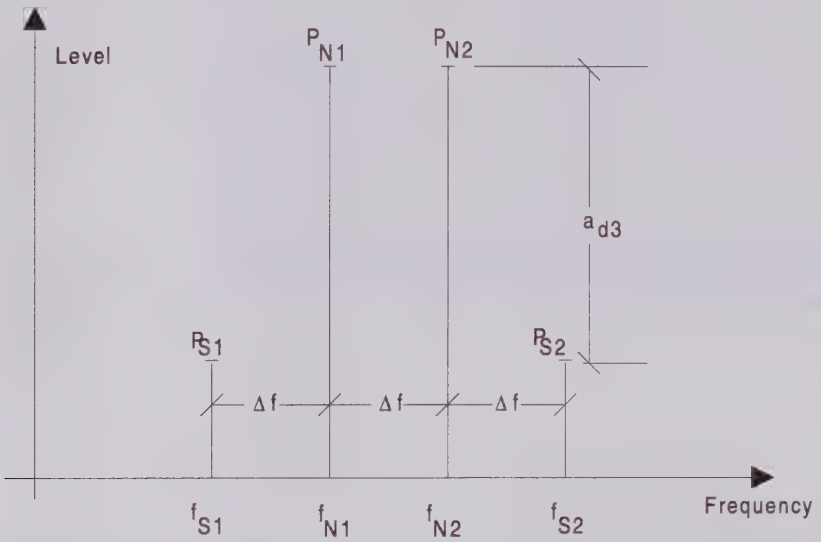


Fig. 2.1-11 Intermodulation products P_{S1} and P_{S2}

The intermodulation product at f_{S2} is obtained by mixture of the first harmonic of the information signal P_{N2} with the signal P_{N1}, the intermodulation product at f_{S1} by mixture of the first harmonic of the information signal P_{N1} with the signal P_{N2} .

$f_{s1} = 2 \times f_{n1} - f_{n2}$ (1)

$f_{s2} = 2 \times f_{n2} - f_{n1}$ (2)

The level of the spurious products depends on the level of the information signals. If both information signals are increased by 1 dB, the level of the spurious responses increases by 3 dB. I.e., the offset a_{d3} of the spurious responses decreases by 2 dB. This is illustrated by fig. 2.1-12.

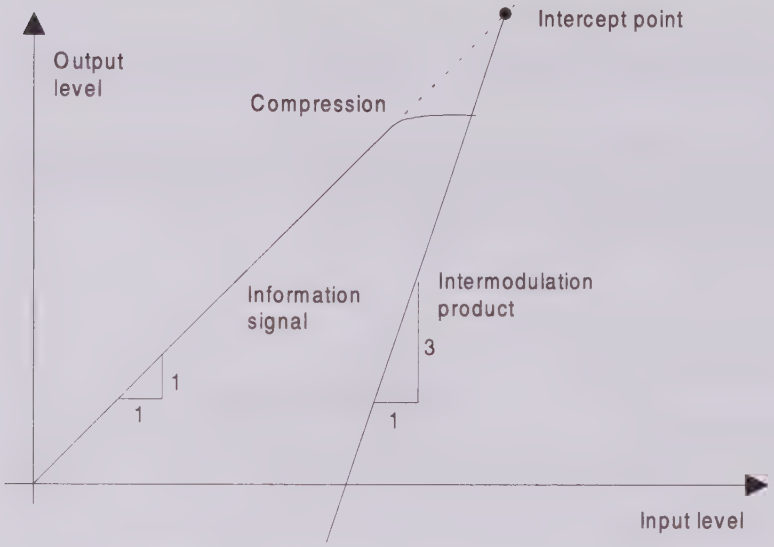


Fig. 2.1-12 Dependance of the spurious product level from the level of the information signals

The information signals at the output of a four-terminal network increase as the input level increases as long as the input level is in the linear range. If the level changes by 1 dB at the input, it also changes by 1 dB at the output. At a specified input level the quadripole compresses and the output level does not increase any more. The third-order intermodulation products increase three times as fast as the information signals. The intercept point is the fictitious level where both lines intersect. It cannot be measured directly since the wanted level is limited by the maximum output power of the quadripole.
It can however be calculated from the known gradients of the lines and the measured intermodulation offset a_{D3} with a given level using the following formula:

$$IP3 = \frac{a_{D3}}{2} + P_N \qquad (3)$$

If, e.g., the intermodulation offset is 60 dB and the input level P_N is -20 dBm, the third-order intercept IP3 is calculated as follows:

$$IP3 = \frac{60}{2} + (-20dBm) = 10dBm. \qquad (4)$$

2.1.3.2 Important Spectrum-Analyzer Functions

Correct setting of the RF attenuation is particularly important for intermodulation measurements. In the FSE, the attenuation can be set automatically according to the reference level. There are three coupling methods:

- RF ATTEN AUTO
- ATTEN AUTO LOW DIST
- ATTEN AUTO LOW NOISE

The coupling mode ATTEN AUTO LOW DIST is recommended to be used for measurement of intermodulation distortions since the intrinsic spurious products are minimized.

2.1.3.3 Measurement

In the following, measurement of the third-order intercept of an amplifier is described, by way of example.

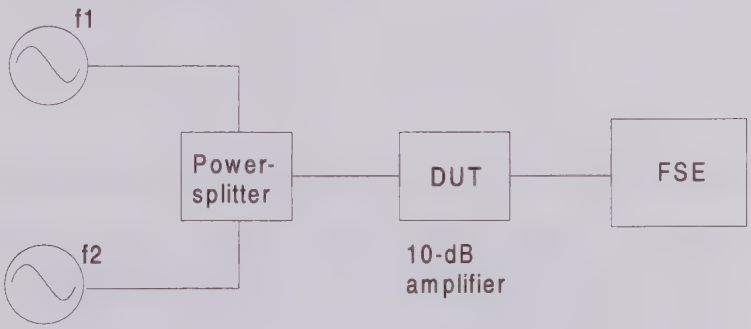
Two signal generators with the frequencies f_1 and f_2 supply signals to the amplifier via a power divider. The output of the device under test is connected to the RF input of the FSE. The level of the two signal generators is the same and is selected such that the DUT is not overloaded.

f_1 = 99.5 MHz

f_2 = 100.5 MHz

Level at amplifier input = -20 dBm with f_1 and $f_2$1

Test setup:



The following measurement steps are carried out:

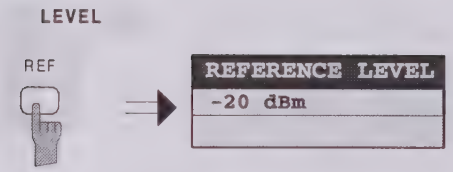
1. Reset the FSE.
2. Set the center frequency to 100 MHz.
3. Set the frequency-display range to 5 MHz (SPAN function).
4. Set the reference level to -10 dBm.
5. Set the resolution bandwidth to 10 kHz.
6. Set the RF attenuation for low-distortion mode.
7. Measure the intercept point using the markers.
8. Calculate IP3 from the measured offset and the signal level according to (4)

Cf. measurement example Level and Frequency Measurements (steps 1 to 3)

1. Reset the instrument.

2. Set the center frequency to 100 MHz.

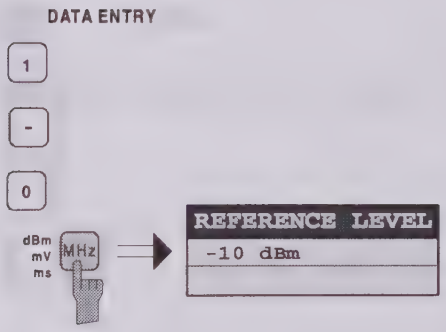
3. Set the frequency-display range to 5 MHz.



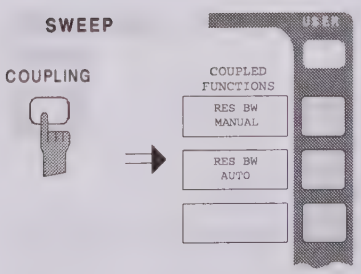
4. Set the reference level to -10 dBm

➢ Press the *REF* key in the *LEVEL* key field.

The entry window for the reference level is displayed.



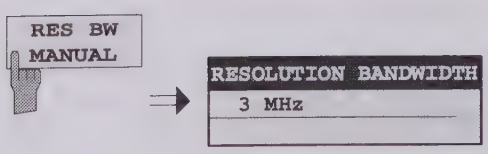
➢ Enter *-10* via the numeric keypad in the entry field and terminate the entry by pressing the *dBm* key.



5. Set the resolution bandwidth to 10 kHz

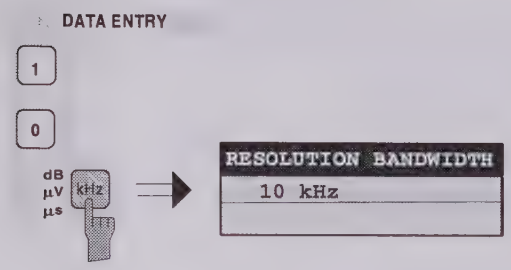
➢ Press the *COUPLING* key in the *SWEEP* key field.

The *SWEEP-COUPLING* menu is opened.

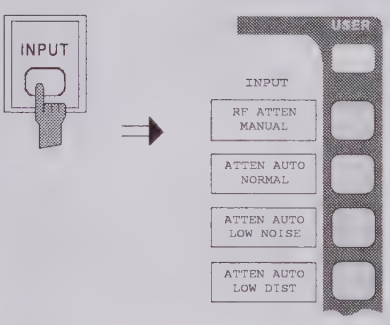


➢ Press the *RES BW MANUAL* softkey.

The entry field for the resolution bandwidth is displayed. .



➢ Enter *10* in the entry field via the numeric keypad and terminate the entry by pressing the *kHz* key.



6. Set low-distortion mode

➢ Press the *INPUT* key

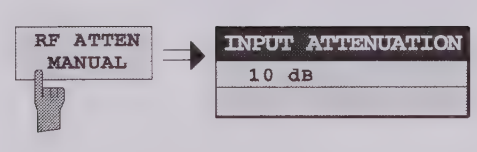
The *INPUT* menu is opened.

either

➢ Press the *ATTEN AUTO LOW DIST* softkey.

The low-distortion mode is selected. Thus, the combination of input attenuation and IF gain is selected such that the internal intermodulation products are the smallest possible and the intermodulation-free range is as large as possible.

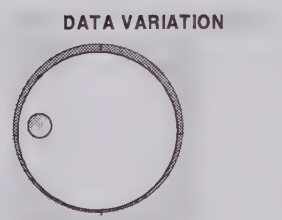
The FSE shows the measuring diagram in fig. 2.1-13



or

➢ Press the *RF ATTEN MANUAL softkey.*

The entry window for the RF attenuation is displayed .



➢ Vary the RF attenuation using the roll-key.

If the amplitude of the IM products doesn't change, the existing setting is sufficient
(see Fig. 2.1-13)

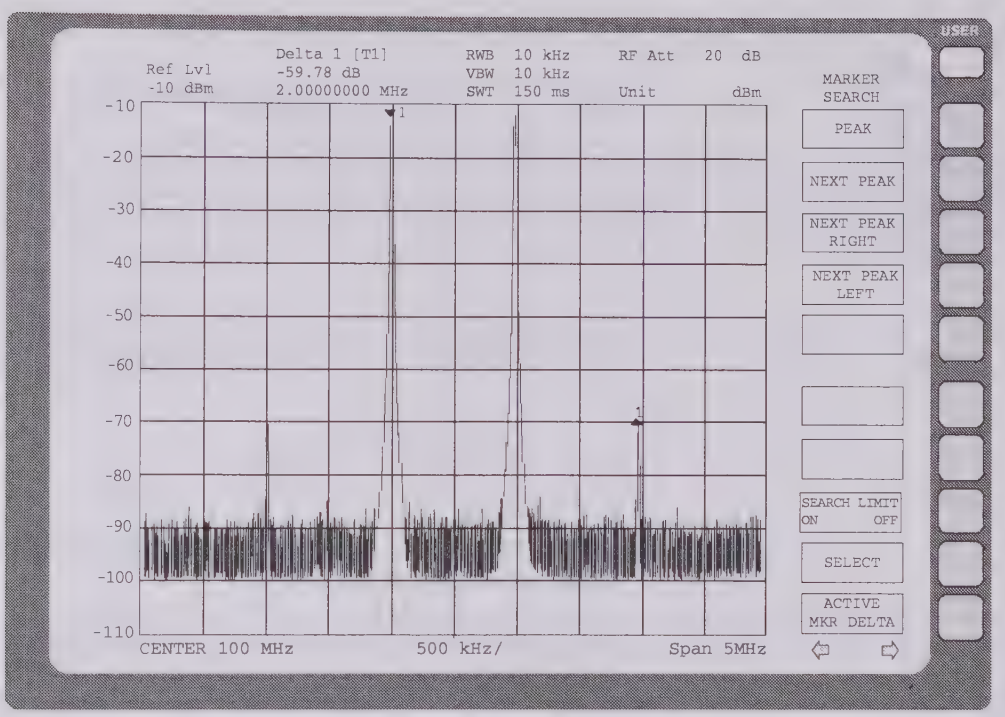


Fig. 2.1-13 Measuring diagram in low distortion mode

MARKER
NORMAL

7. Measure the intercept point using the markers

➢ Press the *NORMAL* key in the *MARKER* key field.

The marker appears on the fundamental (see also level and frequency measurement step 5, PEAK SEARCH function).

The measured values can be read off at the upper left of screen.

MARKER
DELTA

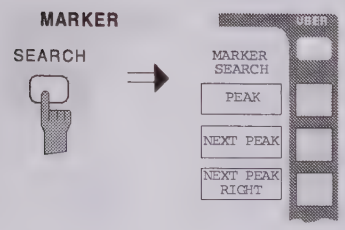
➢ Press the *DELTA* key in the *MARKER* key field.

The delta marker is active. It appears on the fundamental.

DATA VARIATION

either

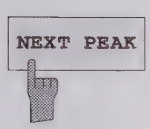
➢ Move the marker to an intermodulation product using the roll-key (see Fig. 2.1-13).



or

➢ Press the *SEARCH* key of the *MARKER* keys.

The *SEARCH-MARKER* menu is opened.



➢ Press the *NEXT PEAK RIGHT* softkey until the delta marker appears on one of the IM products (see fig. 2.1-13).

8. Calculate IP3 from the measured offset and the signal level according to (4)

In the example, an intermodulation ratio of approx. 60 dB at a level of -10 dBm was measured. IP3 is thus:

$$IP3 = 60\ dB/2 + (-10dBm) = 20\ dBm$$

2.1.4 Time-domain Measurements with Pulsed Signals

2.1.4.1 Measuring Task

A lot of systems which handle pulsed signals do not only require measurement of the pulse width and the pulse repetition rate which can be derived from the spectrum but also assess the rise and fall time as well as the power ramping during the pulse. In particular, modern digital mobile radio systems which, like GSM e.g., employ the TDMA method, require the power to be measured versus time over a wide dynamic range.

Time-domain measurements are performed using the spectrum analyzer with ZERO SPAN selected. The analyzer operates as fix-tuned receiver on the set center frequency such that the signal power versus time is displayed.

2.1.4.2 Important Spectrum Analyzer Functions

Trigger functions such as video trigger and sweep settings such as blanking of the measured value (GAP SWEEP) are of particular importance for time-domain measurements. The pretrigger function of the GAP SWEEP just enables measurement of rise times since it allows for representation of measurements prior to the trigger point. The GAP function, which enables cutout of a part of the pulse allows for simultanous representation of both edges of a pulse signal on the screen at high time resolution. During the GAP time, the sweep and thus data acquisition at the time marked by the "GAP" line is interrupted and thus the pulse is not completely displayed (the part which is not important for this measurement is blanked) (see fig. 2.1-14).

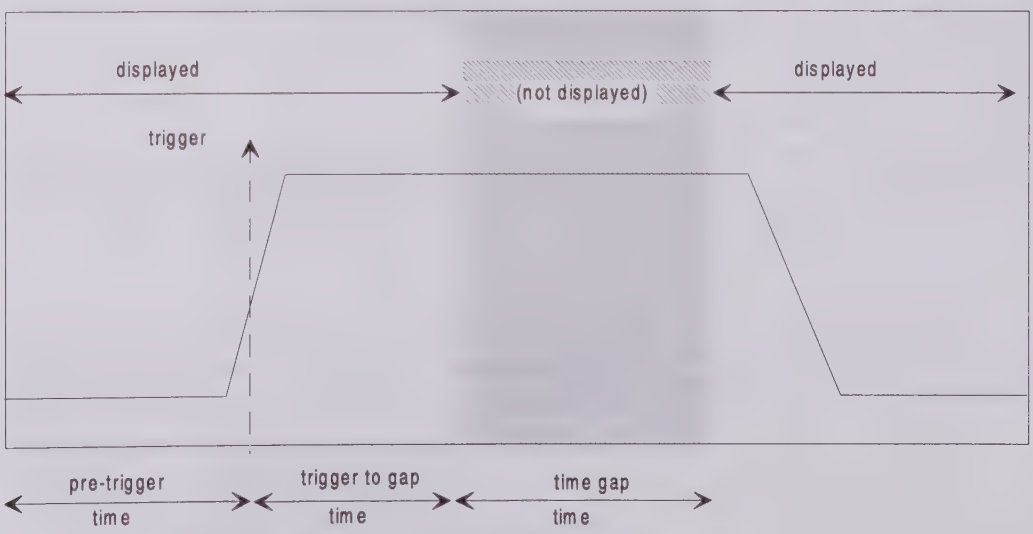


Fig. 2.1-14 Parameter beim Meßwertausblendung – Gap Sweep

Note: *If the pretrigger time and the trg-to-gap time is 0 s, the gap time function has the same effect as a delayed trigger.*

2.1.4.3 Measurement

This example shows the measurement of the rise and fall times as well as the power ramping during the pulse.

The signal generator SME with built-in pulse modulation source SME-B4 is used as signal source. A signal generator providing for pulse modulation in conjunction with an external pulse generator may be used, instead.
Settings on the signal generator:

Frequency	900 MHz
Level	–5 dBm
Modulation	Pulse
Pulse width	ca. 600 µs
Pulse frequency	ca. 500 Hz

The following measuring steps are made:

1. Reset the instrument.
   The video bandwidth is thus set to 3 MHz.
2. Set the center frequency to 900 MHz.
3. Set the frequency display range to zero span.
4. Set the reference level to 0 dBm.
5. Set the resolution bandwidth to 2 MHz.
6. Set the sweep time to 1 ms.
7. Connect the RF output of the SME to the RF input of the FSE.
8. Set the video trigger.
9. Set the sweep time to 100 µs.
10. Set the trigger points.
11. Activate the gap sweep.

---

comp. measuring example - level and frequency measurement (steps 1 to 3)

1. Set the instrument to the default state. I.e., the video bandwidth is set to 3 MHz.

2. Set the center frequency to 900 MHz.

3. Set the frequency-display range to zero span.

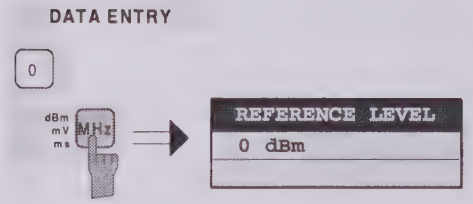
Note: *With first calling of the zero span following preset, a resolution bandwidth of 1 MHz is automatically set. Apart from that, switching on the zero span always causes that resolution bandwidth to be set that was last set in zero span.*

---

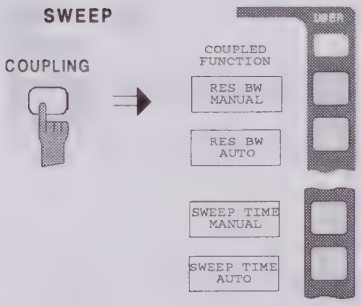
4. Set the reference level to 0 dBm.

➢ Press the *REF* key in the *LEVEL* key field.

The entry field for the reference level appears on the display screen.



➢ Enter *0* in the entry field via the numeric keypad and terminate the entry by pressing the *MHz/ms* key.



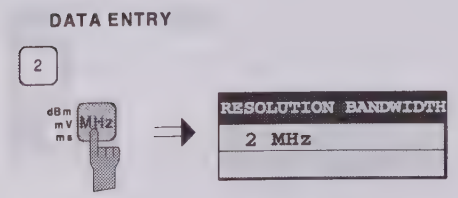
5. Set the resolution bandwidth to 2 MHz

➢ Press the *COUPLING* key in the *SWEEP* key field.

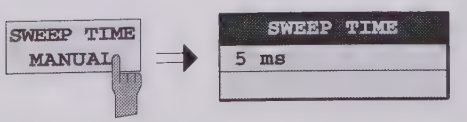
The *SWEEP-COUPLING* menu is opened.

➢ Press the *RES BW MANUAL* soft key.

The entry field for the resolution bandwidth appears on the display screen.



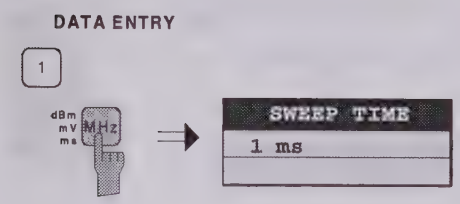
➢ Enter *2* via the numeric key pad and terminate the entry by pressing the *MHz* key.



6. Set the sweep time to 1 ms

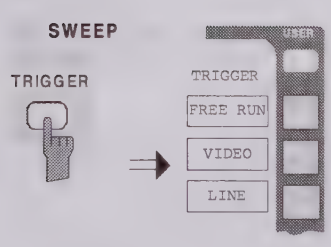
➢ Press the *SWEEP TIME MANUAL* softkey.

The entry field for the sweep time is opened.



➢ Enter *1* in the entry field via the numeric keypad and terminate the entry by pressing the *MHz* key.

7. Connect the RF output of the SME to the RF input of the FSE.



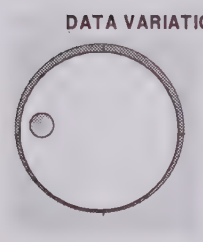
8. Initiate triggering by means of the display voltage (video trigger)

➢ Press the *TRIGGER* key in the *SWEEP* key field

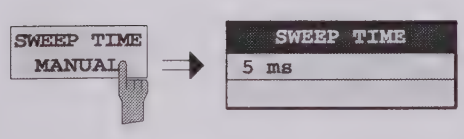
The *TRIGGER* menu is opened.

➢ Press the *VIDEO* softkey.

A dashed horizontal line is displayed which marks the trigger level.



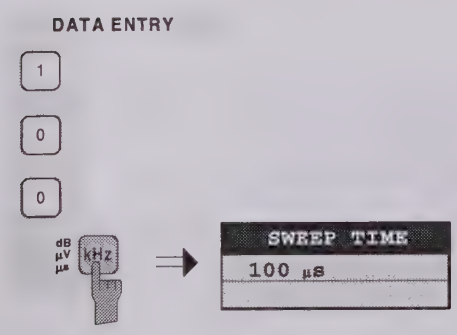
➢ Set the trigger level using the roll key such that a triggered display is obtained.
(see fig. 2.1-15)



9. Set the sweep time to 100 µs

➢ Press the *SWEEP TIME MANUAL* softkey.

The window for entering the sweep time is opened.



➢ Enter *100* via the numeric keypad and terminate the entry by pressing the *kHz/µs* key.

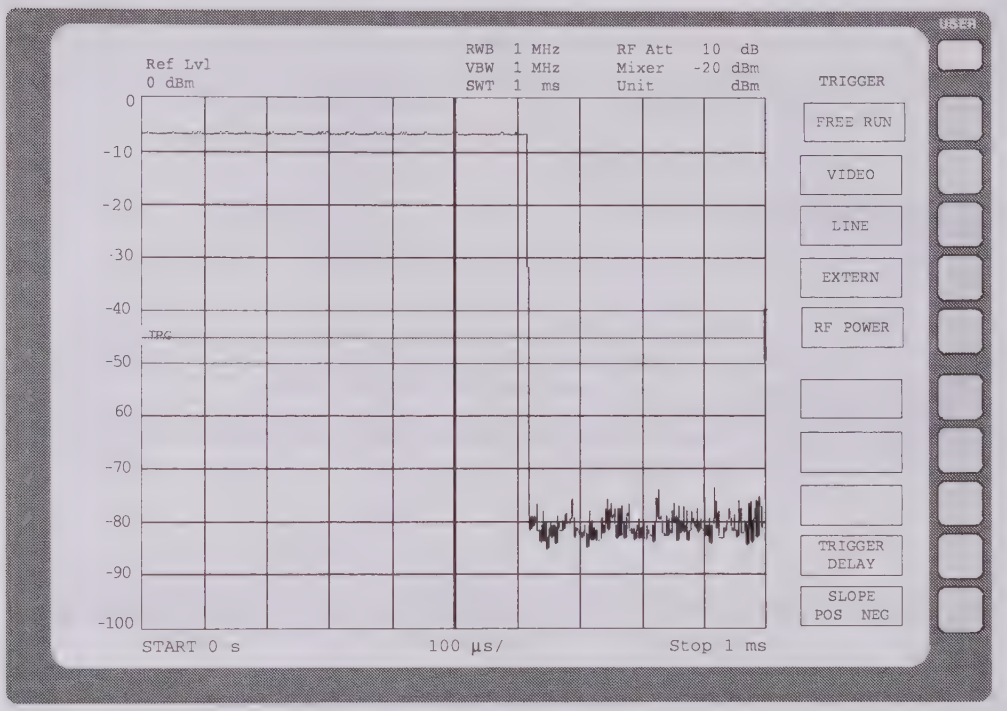
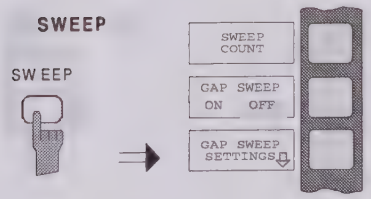


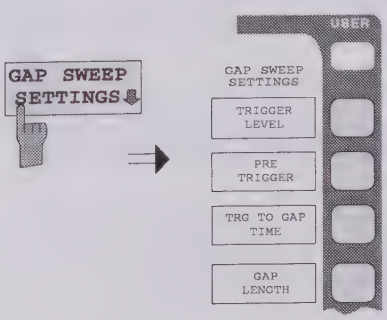
Fig. 2.1-15 Representation of pulse sequence with video trigger



10. Set the trigger points.

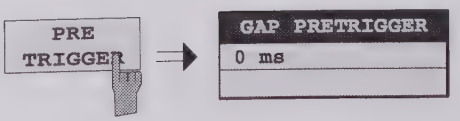
➢ Press the *SWEEP* key in the *SWEEP* keyfield.

The *SWEEP* menu is opened.



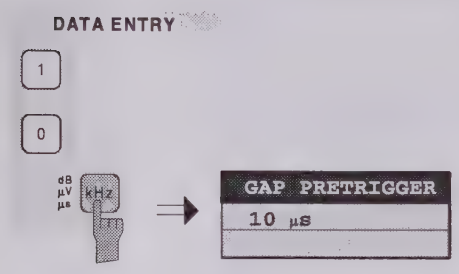
➢ Press the *GAP SWEEP SETTINGS* softkey.

The *GAP SWEEP SETTINGS* submenu for setting the trigger points is opened.

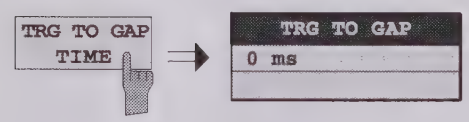


➢ Press the *PRE TRIGGER* softkey.

The entry field for the pretrigger is opened.

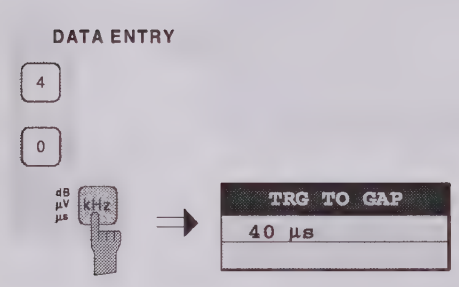


➢ Enter *10* via the numeric keypad in the entry field and terminate the entry by pressing the *kHz/µs* key.



➢ Press the *TRG TO GAP* softkey.

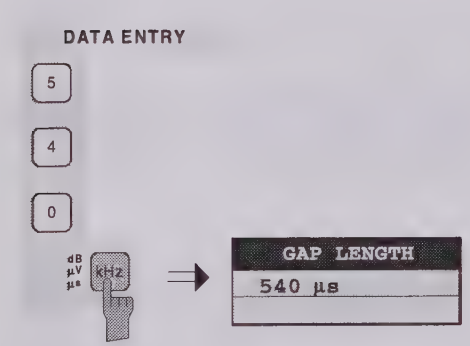
The entry field for the trigger-to-gap-time is opened.



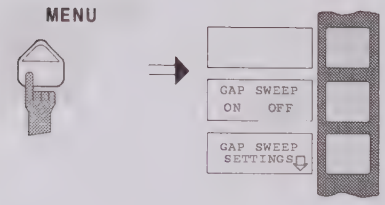
➢ Enter *40* via the numeric keypad in the entry field and terminate the entry by pressing the *kHz/µs* key.

➢ Press the *GAP LENGTH* softkey.

The entry field for the length of the time gap is opened.



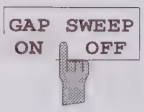
➢ Enter *540* in the entry field via the numeric keypad and terminate the entry by pressing the *kHz/µs* key.



11. *Activate the measurement with mask-out of measured value*

➢ Press the menu change key.

The right supplementary menu is opened.



➢ Press the *GAP SWEEP ON/OFF* key.

The measurement with blanking of measured value is activated. The measurement results are shown in figure 2.1-16

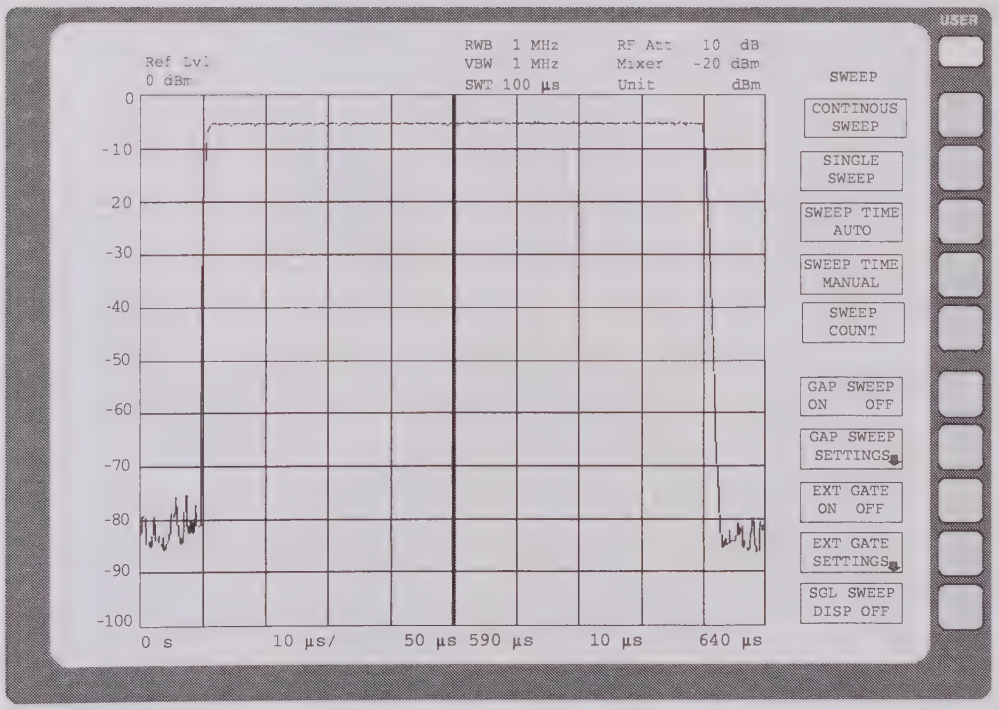


Fig. 2.1-16 Measured-value blanking for simultaneous display of rising and falling edge of a pulse signal. The position of the gap is indicated by the thick vertical line. The gap time is indicated via the double label 50 µs and 590 µs in the time axis.

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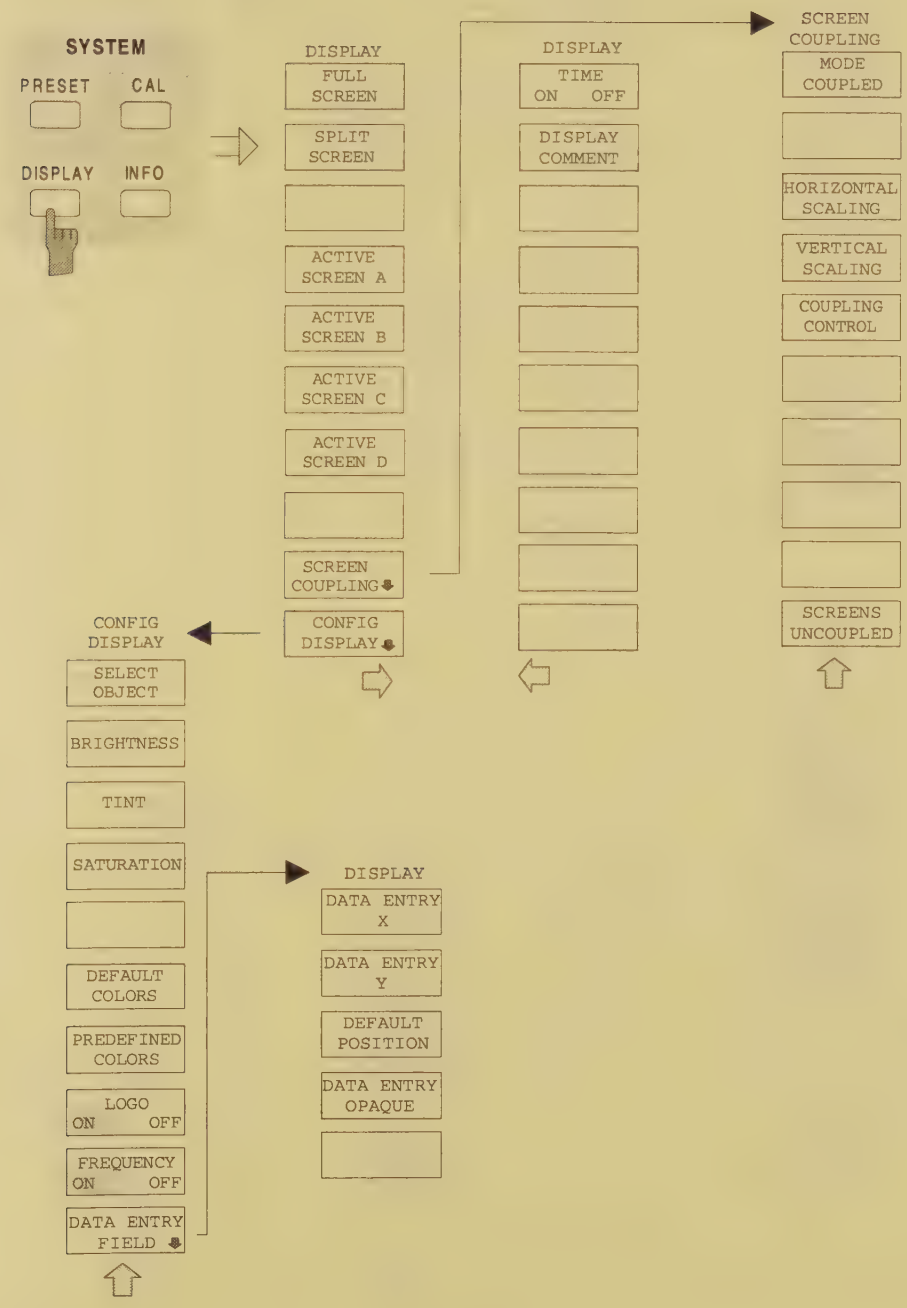
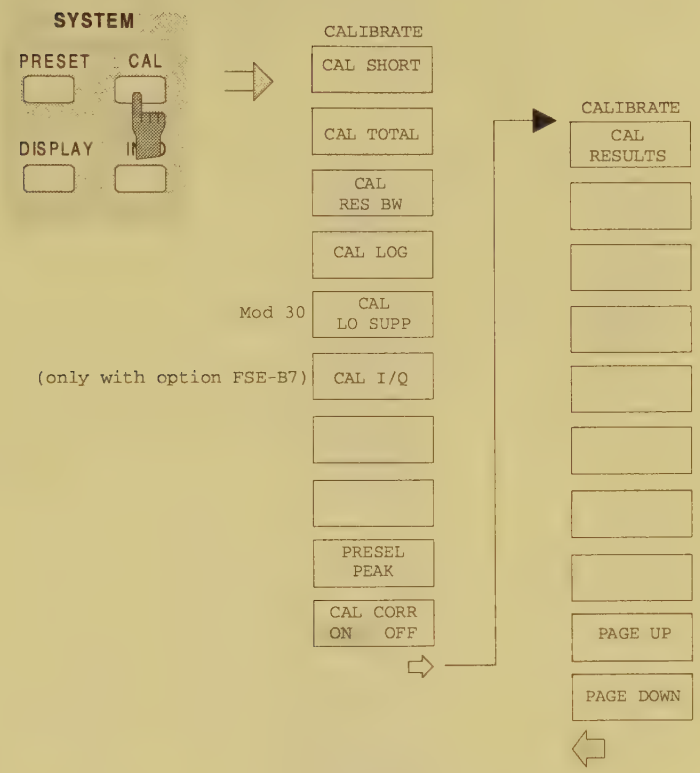
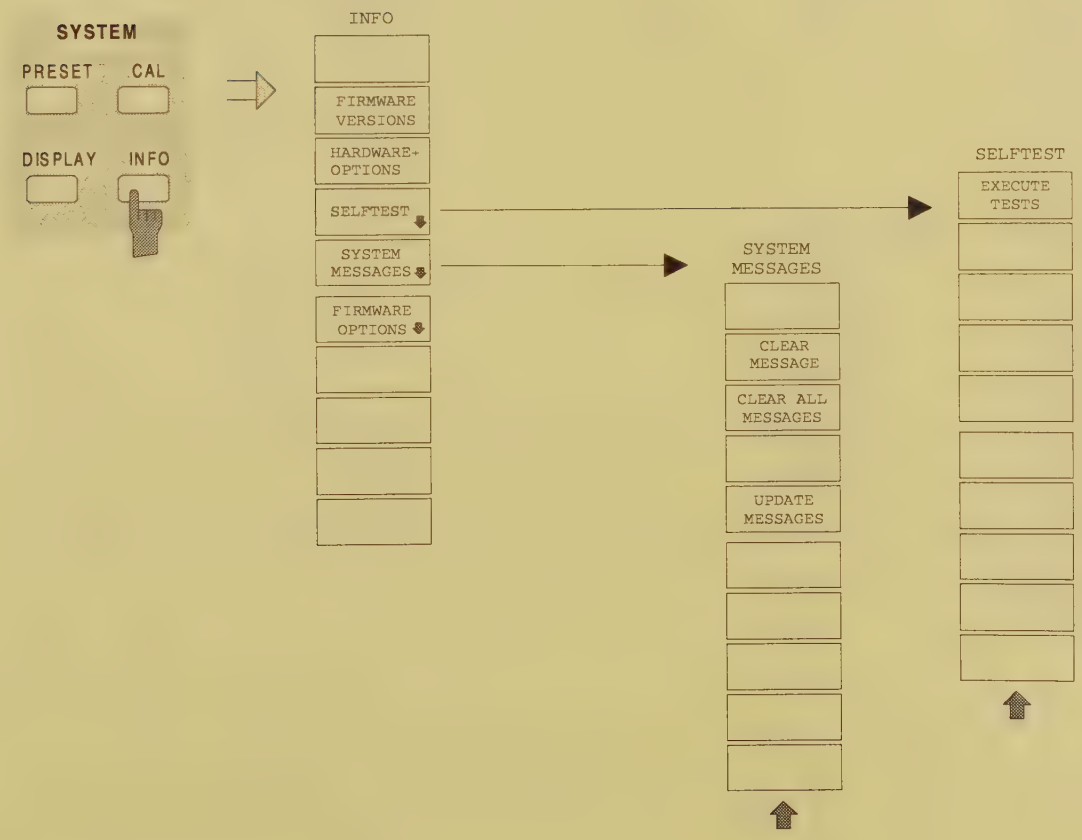
2.2 Menu Overview

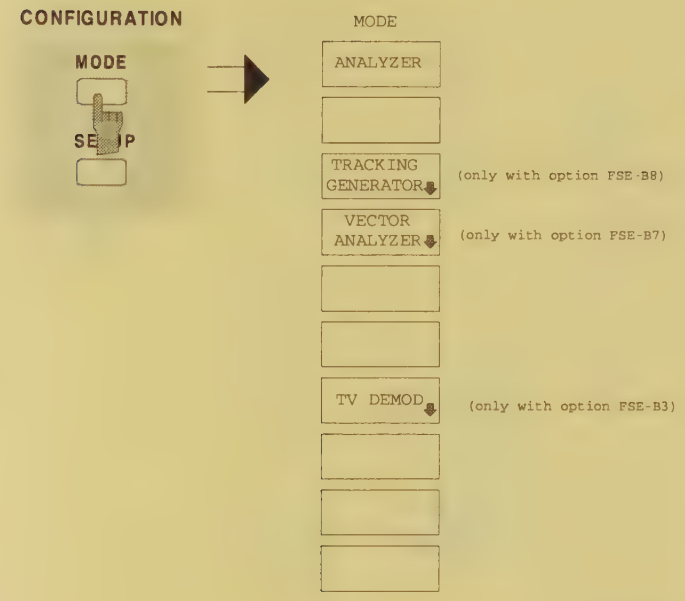
2.2.1 System Key Group

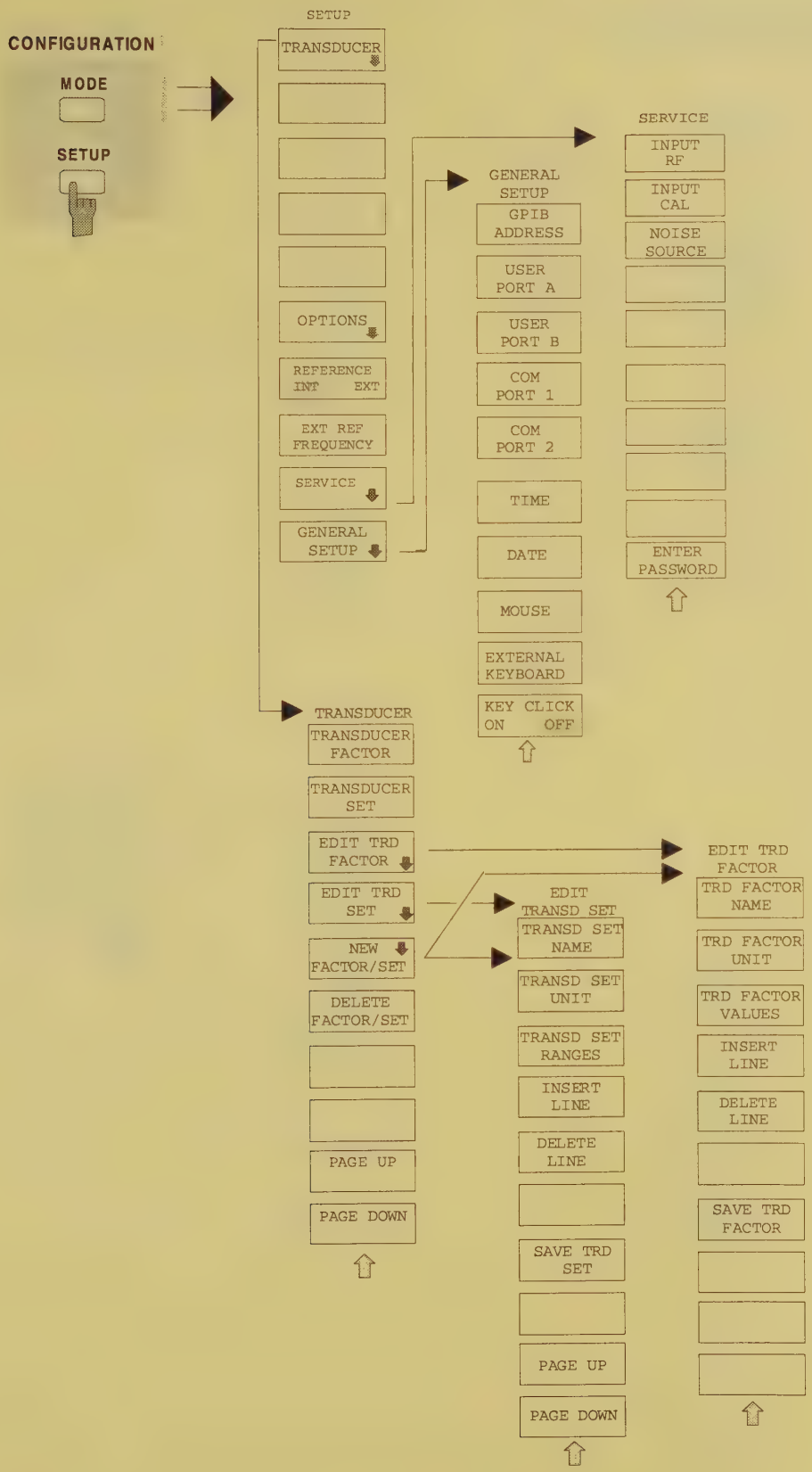



SYSTEM
PRESET
CAL
DISPLAY
CALIBRATE
CAL SHORT
CAL TOTAL
CAL RES BW
CAL LOG
Mod 30
CAL LO SUPP
(only with option FSE-B7)
CAL I/Q
PRESEL PEAK
CAL CORR ON OFF
CALIBRATE
CAL RESULTS
PAGE UP
PAGE DOWN

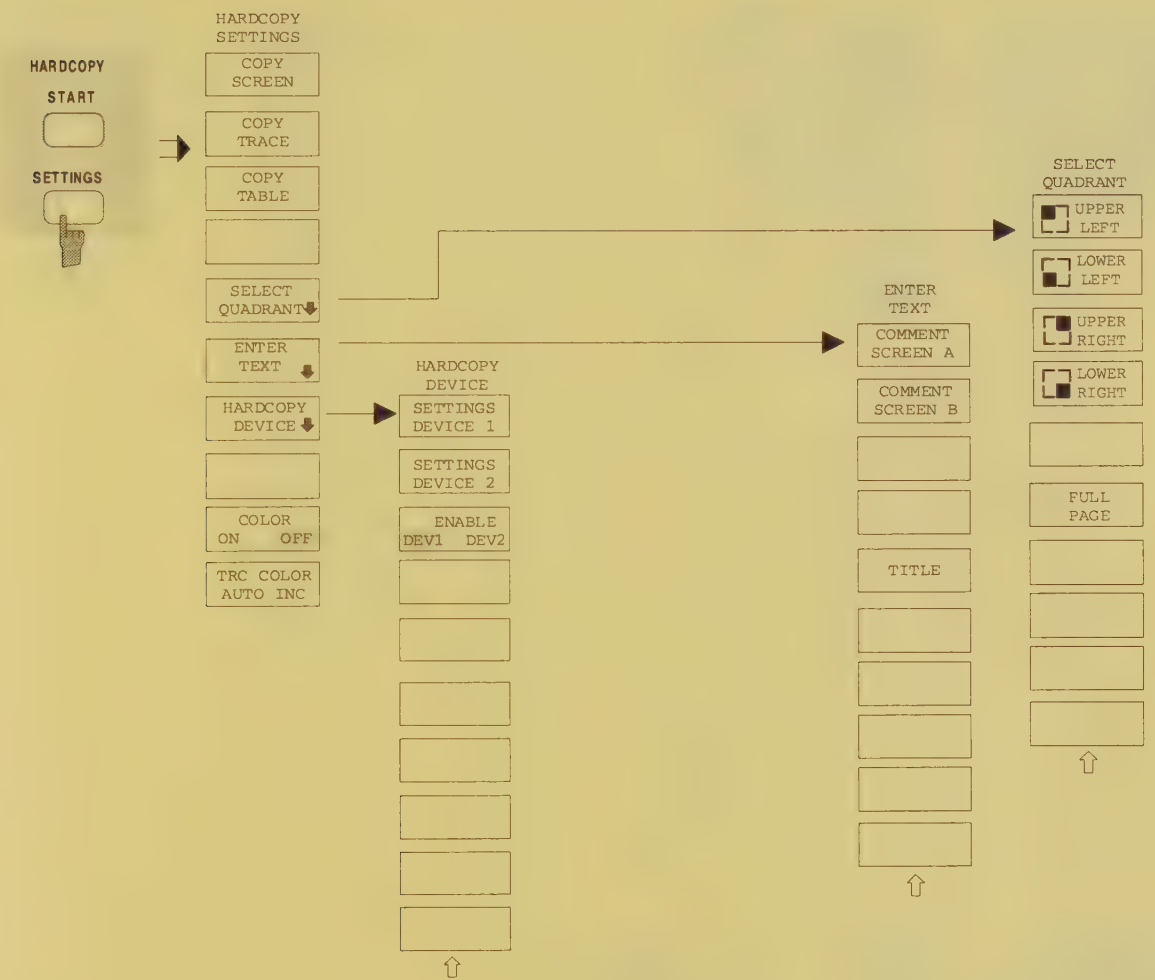

SYSTEM
PRESET
CAL
DISPLAY
INFO
INFO
FIRMWARE VERSIONS
HARDWARE+ OPTIONS
SELFTEST
SYSTEM MESSAGES
FIRMWARE OPTIONS
SELFTEST
EXECUTE TESTS
SYSTEM MESSAGES
CLEAR MESSAGE
CLEAR ALL MESSAGES
UPDATE MESSAGES

2.2.2 Configuration Key Group



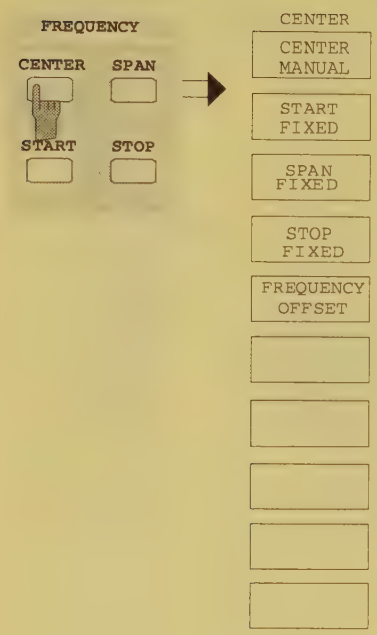

CONFIGURATION
MODE
SETUP
SETUP
TRANSDUCER
OPTIONS
REFERENCE INT EXT
EXT REF FREQUENCY
SERVICE
GENERAL SETUP
SERVICE
INPUT RF
INPUT CAL
NOISE SOURCE
ENTER PASSWORD
GENERAL SETUP
GPIB ADDRESS
USER PORT A
USER PORT B
COM PORT 1
COM PORT 2
TIME
DATE
MOUSE
EXTERNAL KEYBOARD
KEY CLICK ON OFF
TRANSDUCER
TRANSDUCER FACTOR
TRANSDUCER SET
EDIT TRD FACTOR
EDIT TRD SET
NEW FACTOR/SET
DELETE FACTOR/SET
PAGE UP
PAGE DOWN
EDIT TRANSD SET
TRANSD SET NAME
TRANSD SET UNIT
TRANSD SET RANGES
INSERT LINE
DELETE LINE
SAVE TRD SET
PAGE UP
PAGE DOWN
EDIT TRD FACTOR
TRD FACTOR NAME
TRD FACTOR UNIT
TRD FACTOR VALUES
INSERT LINE
DELETE LINE
SAVE TRD FACTOR

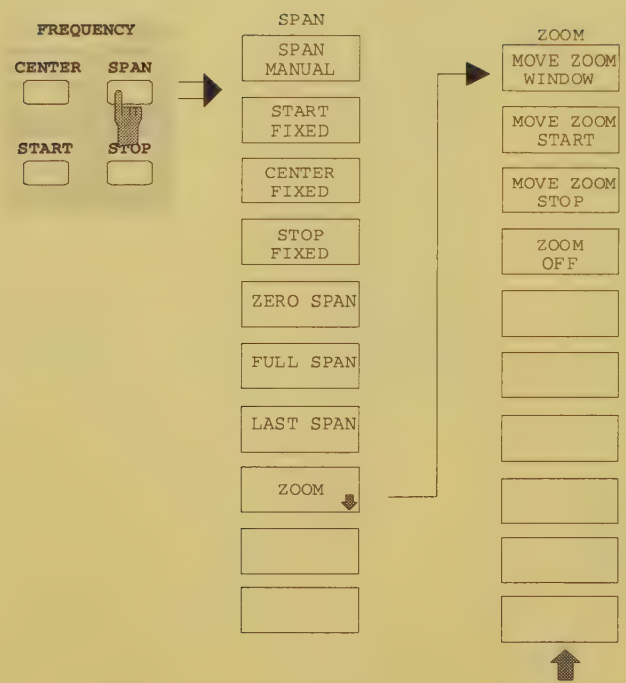
2.2.3 Hardcopy Key Group

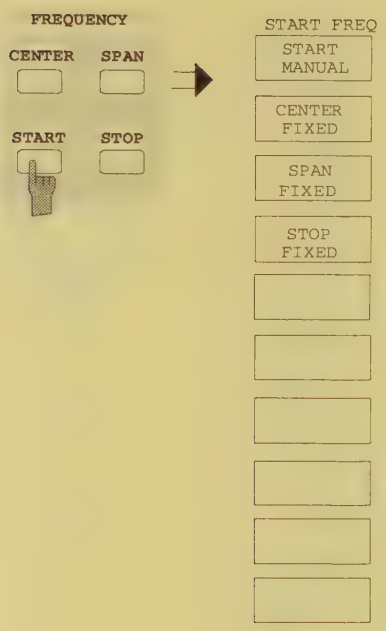


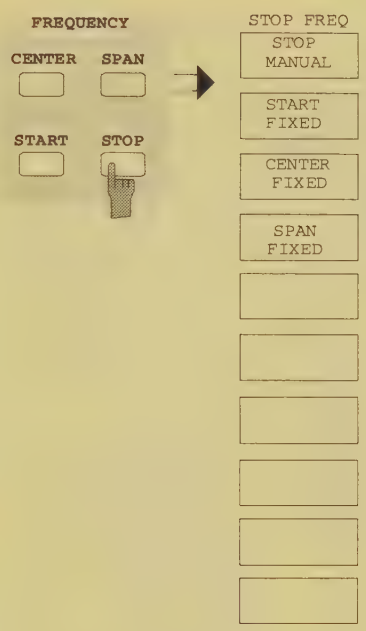
without soft key menu

2.2.4 Frequency Key Group

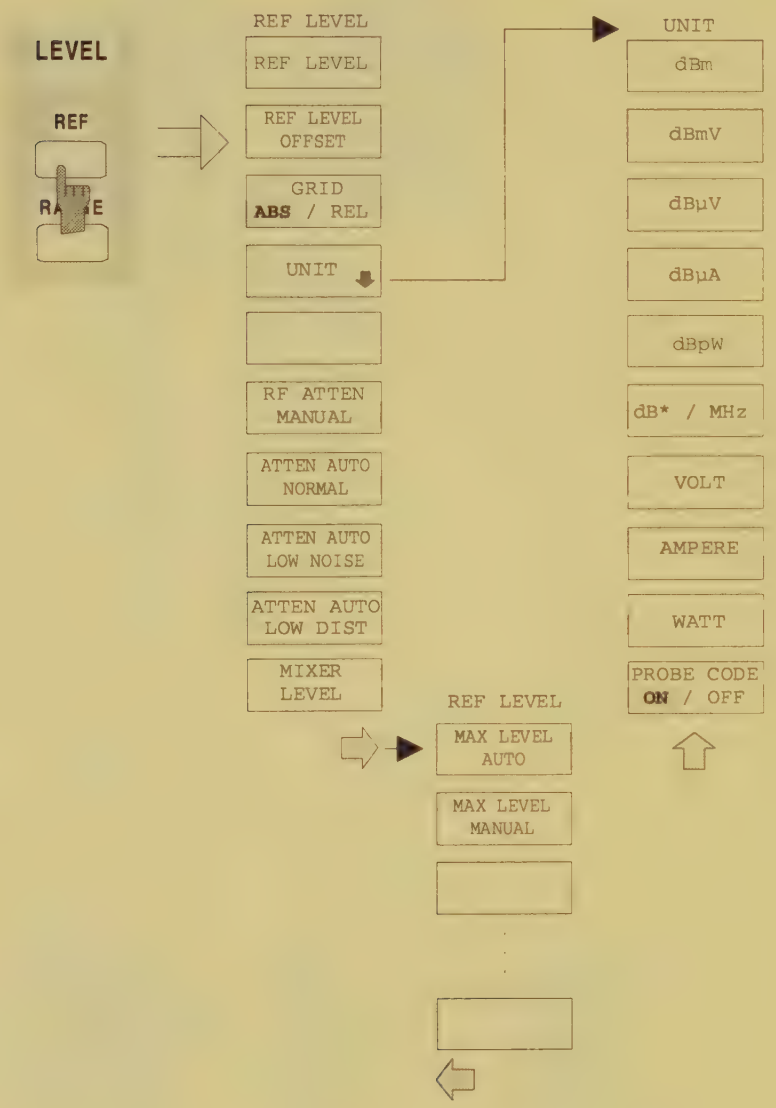





FREQUENCY
CENTER
SPAN
START
STOP
START FREQ
START MANUAL
CENTER FIXED
SPAN FIXED
STOP FIXED

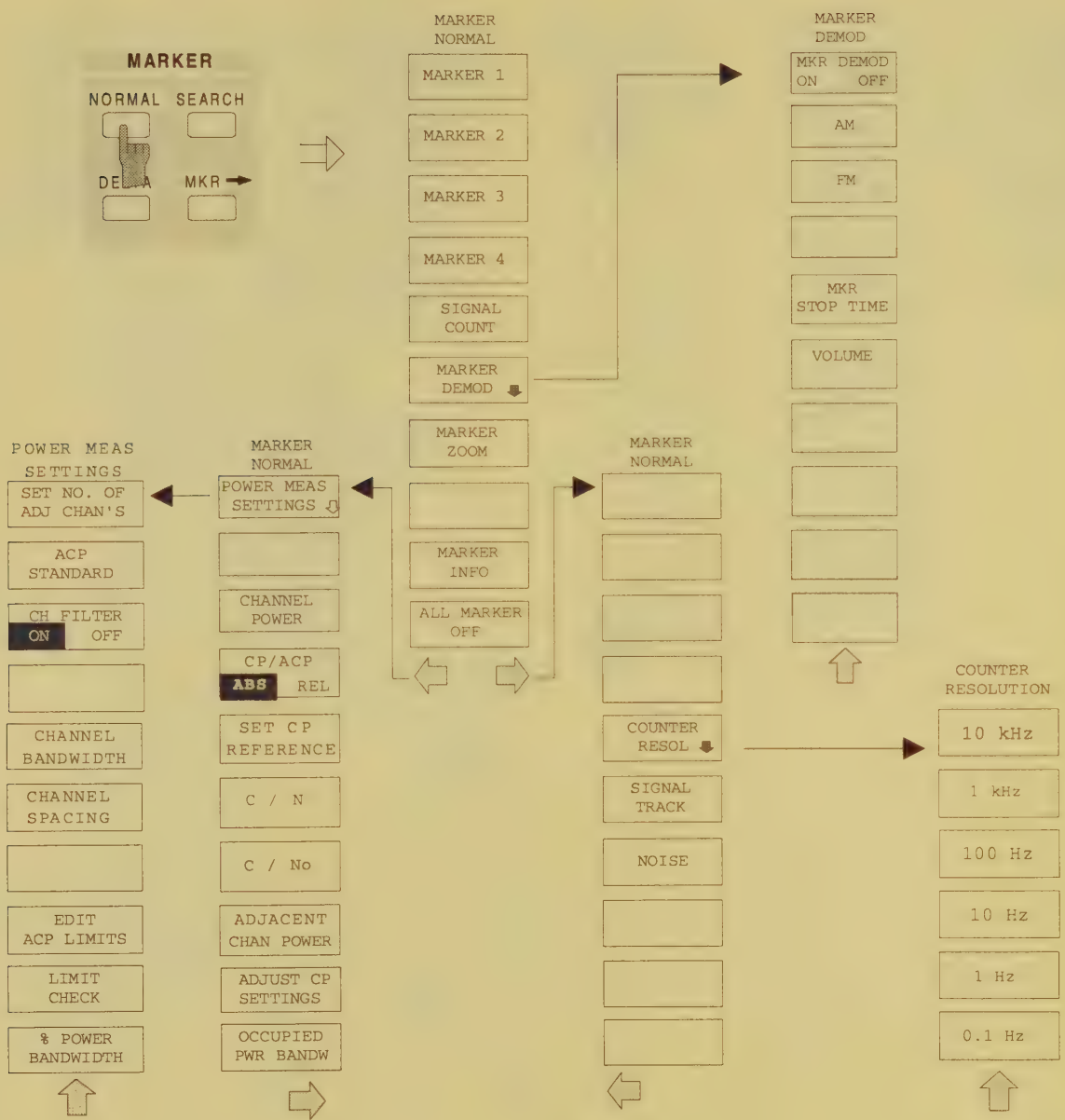

FREQUENCY
CENTER
SPAN
START
STOP
STOP FREQ
STOP MANUAL
START FIXED
CENTER FIXED
SPAN FIXED

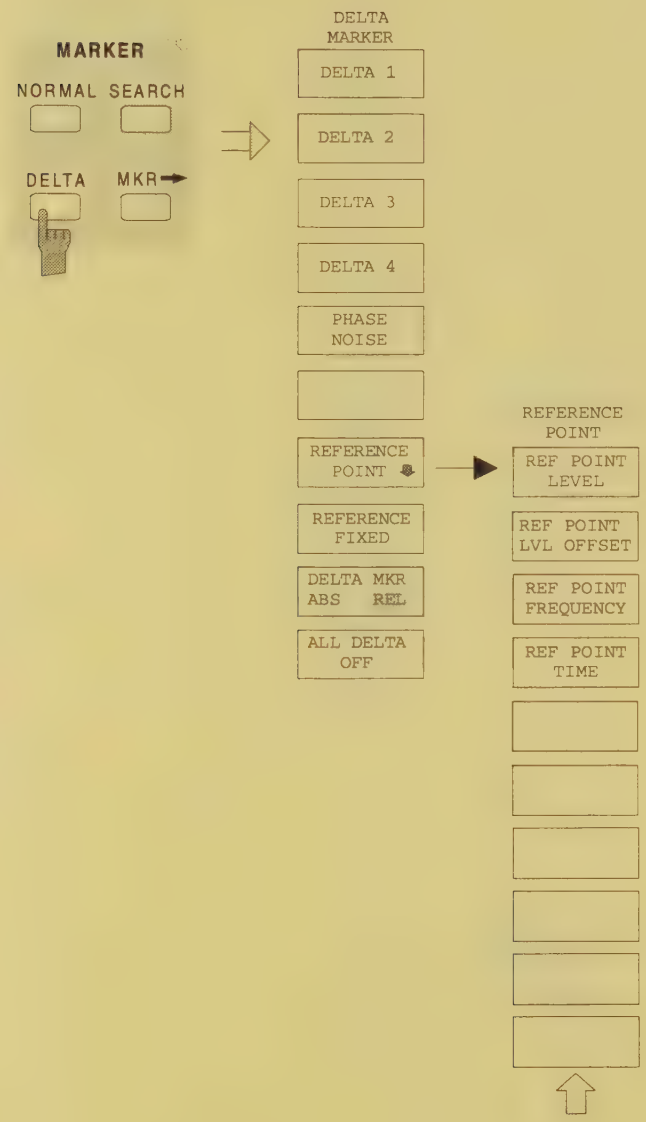
2.2.5 Level Key Group, Input Key

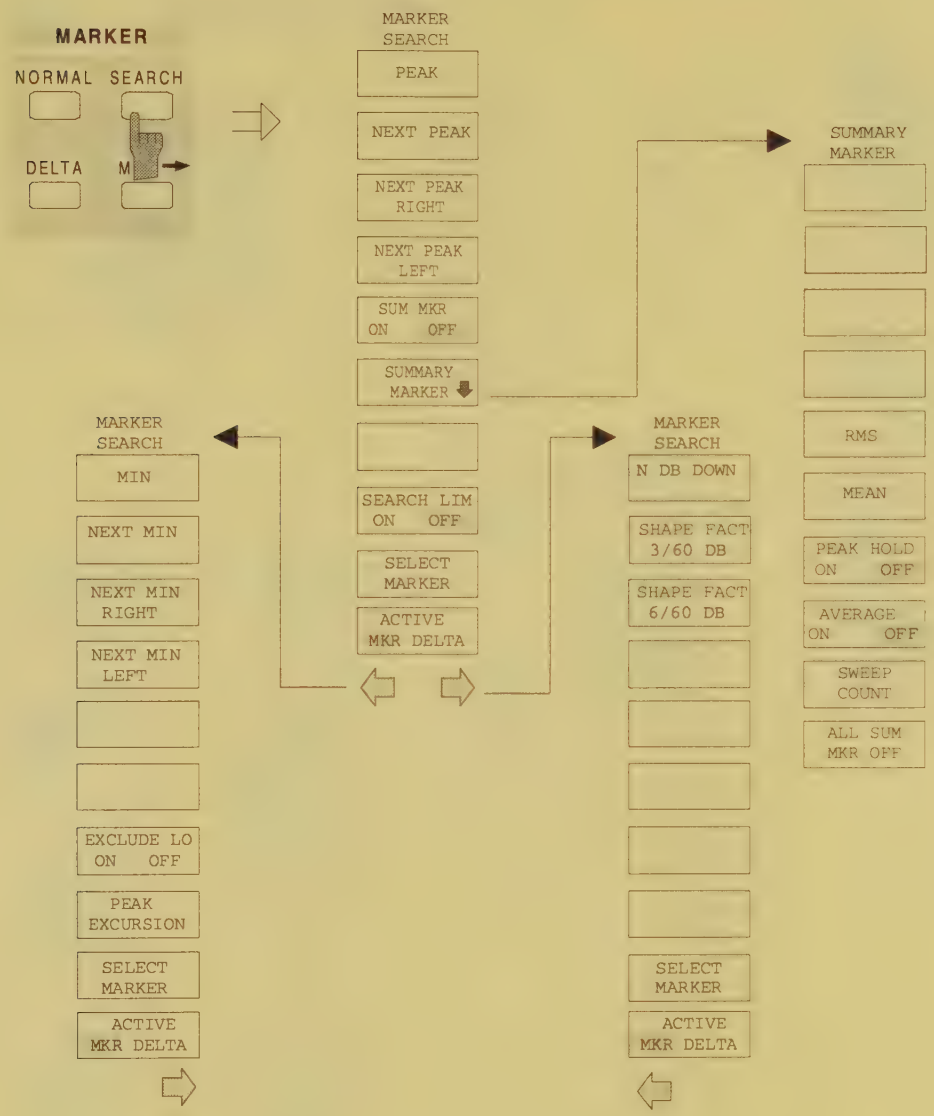


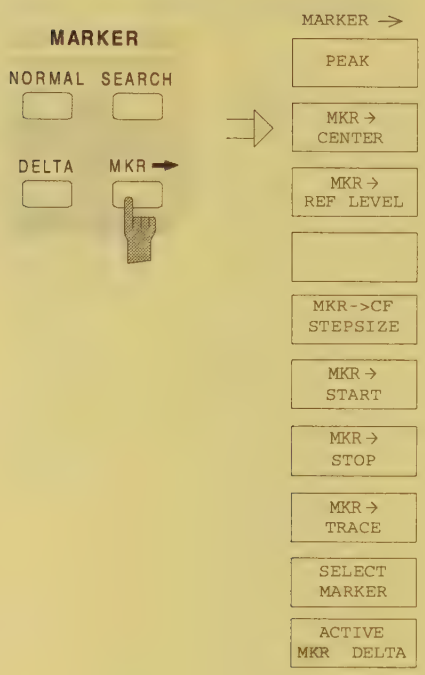
LEVEL
REF
RANGE
LEVEL RANGE
LOG 120 dB
LOG 100 dB
LOG 50 dB
LOG 20 dB
LOG 10 dB
LOG MANUAL
LINEAR/dB
LINEAR/%
GRID ABS / REL
INPUT
INPUT
RF ATTEN MANUAL
ATTEN AUTO NORMAL
ATTEN AUTO LOW NOISE
ATTEN AUTO LOW DIST
MIXER LEVEL
INPUT SELECT
INPUT SELECT
RF INPUT 50 OHM
RF INPUT 75 OHM/RAM
RF INPUT 75 OHM/RAZ

2.2.6 Marker Key Group

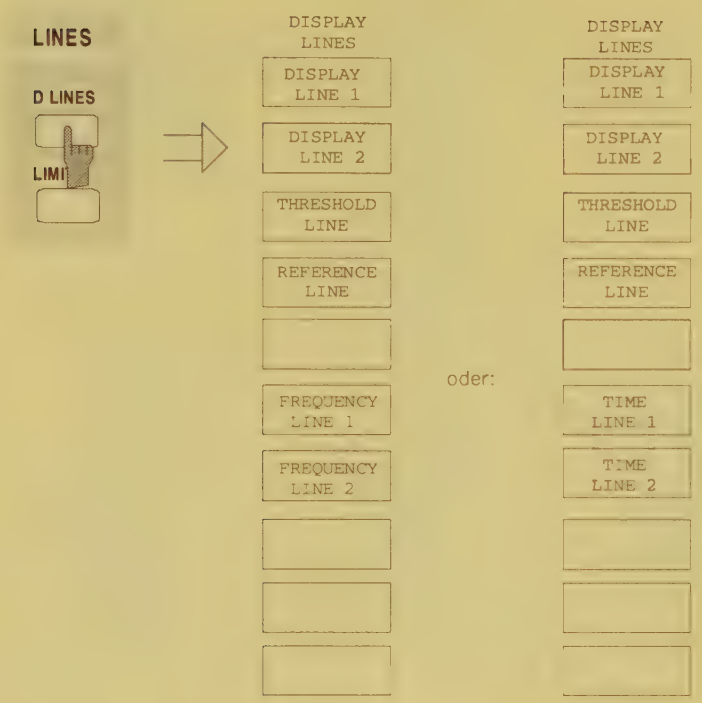


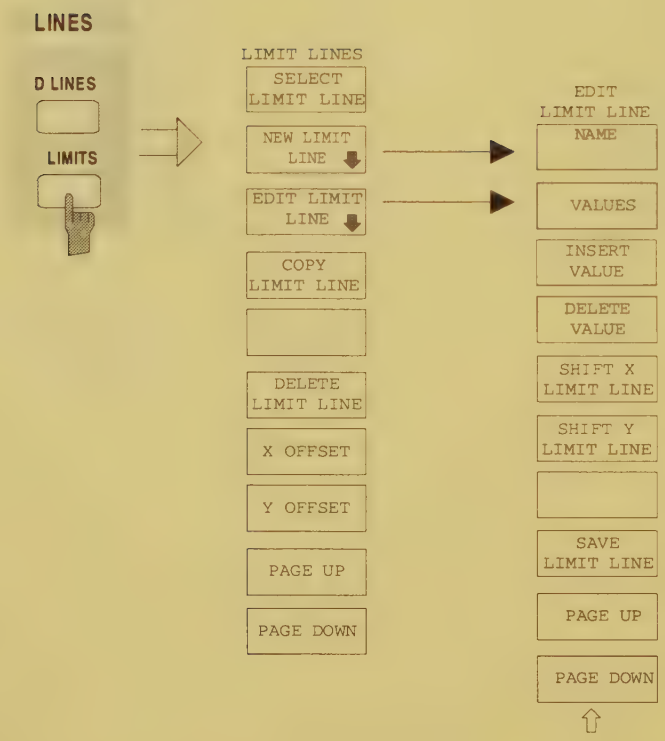

MARKER
NORMAL
SEARCH
DELTA
MKR
DELTA MARKER
DELTA 1
DELTA 2
DELTA 3
DELTA 4
PHASE NOISE
REFERENCE POINT
REFERENCE FIXED
DELTA MKR ABS REL
ALL DELTA OFF
REFERENCE POINT
REF POINT LEVEL
REF POINT LVL OFFSET
REF POINT FREQUENCY
REF POINT TIME


MARKER
NORMAL
SEARCH
DELTA
MARKER SEARCH
PEAK
NEXT PEAK
NEXT PEAK RIGHT
NEXT PEAK LEFT
SUM MKR ON OFF
SUMMARY MARKER
SEARCH LIM ON OFF
SELECT MARKER
ACTIVE MKR DELTA
SUMMARY MARKER
RMS
MEAN
PEAK HOLD ON OFF
AVERAGE ON OFF
SWEEP COUNT
ALL SUM MKR OFF
MARKER SEARCH
N DB DOWN
SHAPE FACT 3/60 DB
SHAPE FACT 6/60 DB
SELECT MARKER
ACTIVE MKR DELTA
MARKER SEARCH
MIN
NEXT MIN
NEXT MIN RIGHT
NEXT MIN LEFT
EXCLUDE LO ON OFF
PEAK EXCURSION
SELECT MARKER
ACTIVE MKR DELTA

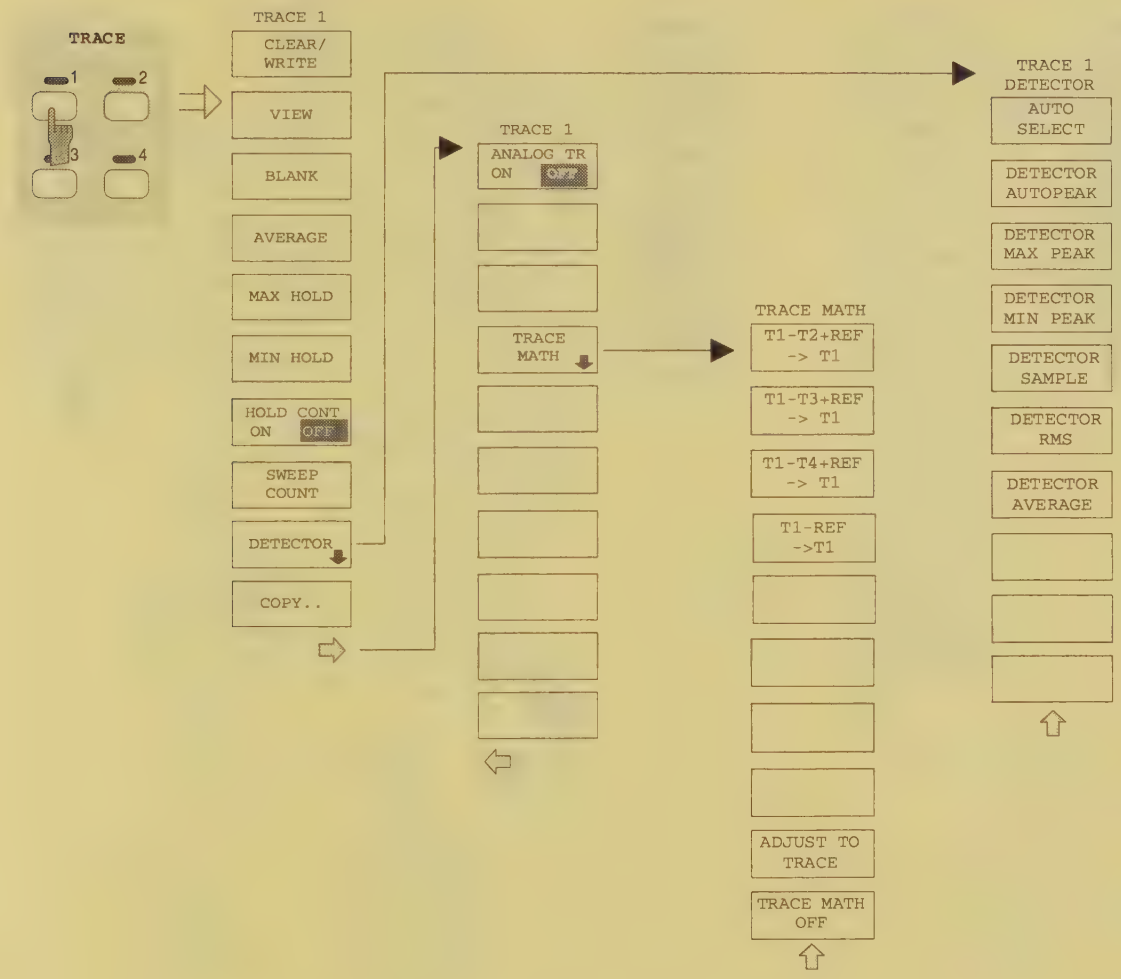

MARKER
NORMAL
SEARCH
DELTA
MKR
MARKER →
PEAK
MKR →
CENTER
MKR →
REF LEVEL
MKR->CF
STEPSIZE
MKR →
START
MKR →
STOP
MKR →
TRACE
SELECT
MARKER
ACTIVE
MKR DELTA

2.2.7 Lines Key Group

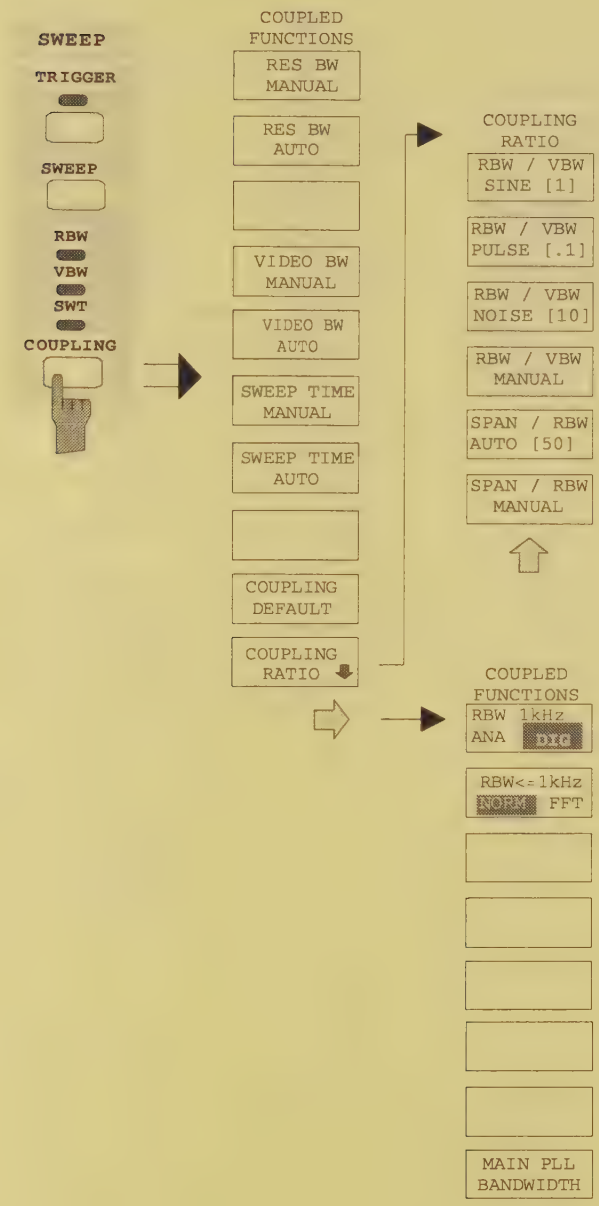




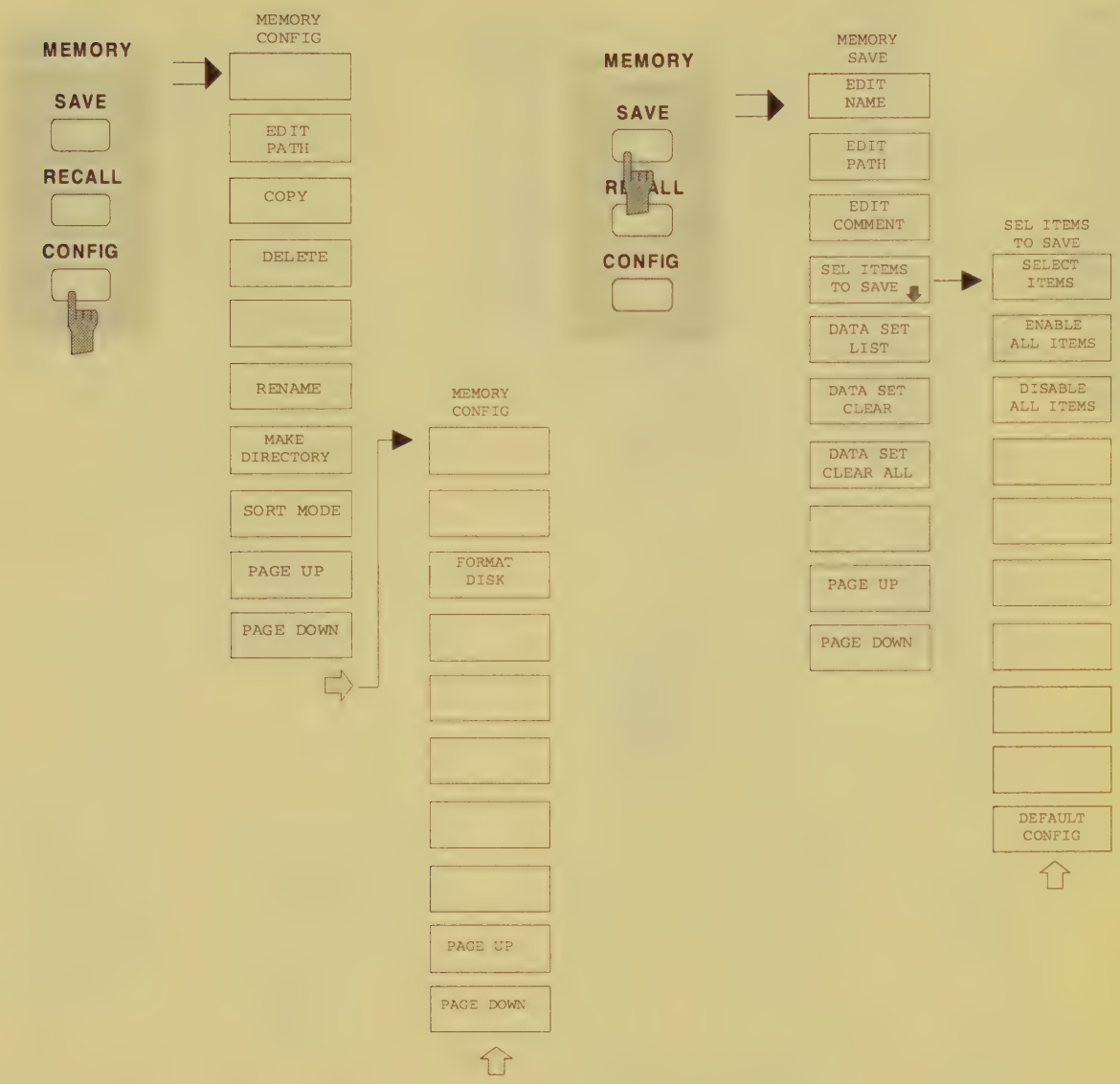
2.2.8 Trace Key Group

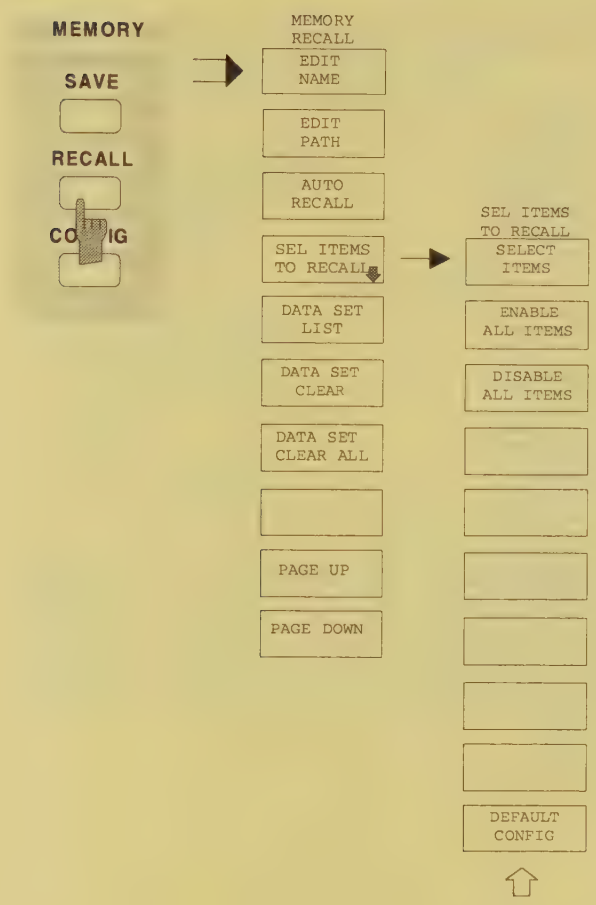


2.2.9 Sweep Key Group

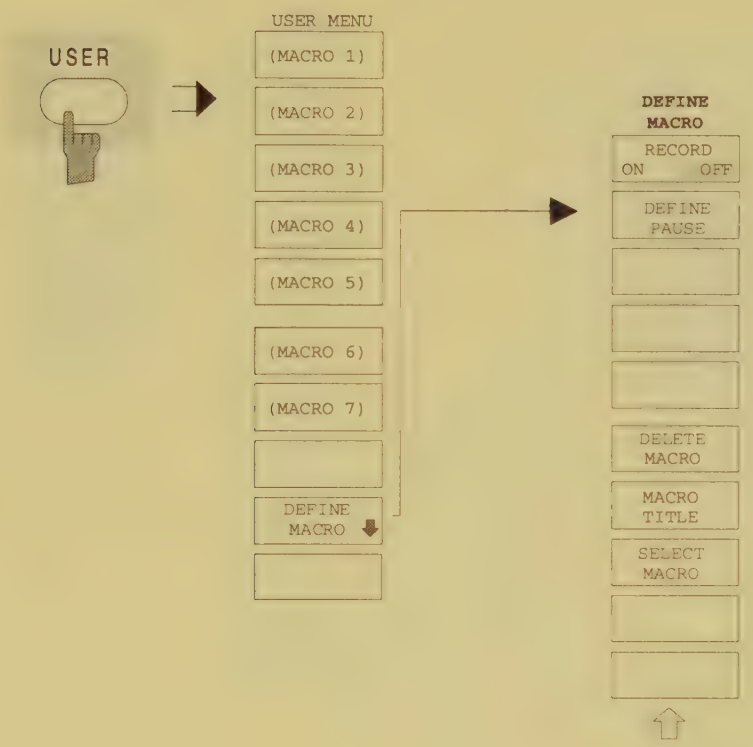

SWEEP
TRIGGER
SWEEP
RBW
VBW
SWT
COUPLING
COUPLED FUNCTIONS
RES BW MANUAL
RES BW AUTO
VIDEO BW MANUAL
VIDEO BW AUTO
SWEEP TIME MANUAL
SWEEP TIME AUTO
COUPLING DEFAULT
COUPLING RATIO
COUPLING RATIO
RBW / VBW SINE [1]
RBW / VBW PULSE [.1]
RBW / VBW NOISE [10]
RBW / VBW MANUAL
SPAN / RBW AUTO [50]
SPAN / RBW MANUAL
COUPLED FUNCTIONS
RBW 1kHz
ANA DIG
RBW<=1kHz
NORM FFT
MAIN PLL BANDWIDTH

2.2.10 Memory Key Group




MEMORY
SAVE
RECALL
CONFIG
MEMORY RECALL
EDIT NAME
EDIT PATH
AUTO RECALL
SEL ITEMS TO RECALL
DATA SET LIST
DATA SET CLEAR
DATA SET CLEAR ALL
PAGE UP
PAGE DOWN
SEL ITEMS TO RECALL
SELECT ITEMS
ENABLE ALL ITEMS
DISABLE ALL ITEMS
DEFAULT CONFIG

2.2.11 User Key Group



2.3 Basic Steps of Operation

After switching on the instrument a message about the BIOS version installed is displayed for a few seconds (e.g. "Analyzer BIOS Rev. 1.2").

The results of the self test is displayed next.

```
MAINPROCESSOR
SELFTEST STARTING ...
TESTING CMOS ...
DMA CHANNEL ...
INTERRUPTS ...
NMI ...
BASE MEMORY ...
EXTENDED MEMORY ...
HD CAPACITY ...
INIT FLOPPY DRIVE ...
INIT HD ...

SELFTEST DONE,
SYSTEM IS BOOTING ...
```

Subsequently, the individual parts of the system are loaded and the instrument starts measuring. The type of measurement which was activated prior to last switch-off is performed, as long as no other instrument configuration was selected via *AUTO RECALL* in the *MEMORY RECALL* menu. While the measurement is being performed other menus and measuring modes can be entered simultaneously. The measurement results and the settings of the parameters are displayed on the screen.

2.3.1 The Screen

The screen informs continuously on the results and parameters of the selected measuring functions. It shows the assignment of the softkeys and menus, which are required for setting the measuring parameters. The display of test results, the softkey labeling and the type of menu depend on the selected measuring function.

The screen is subdivided into two areas:

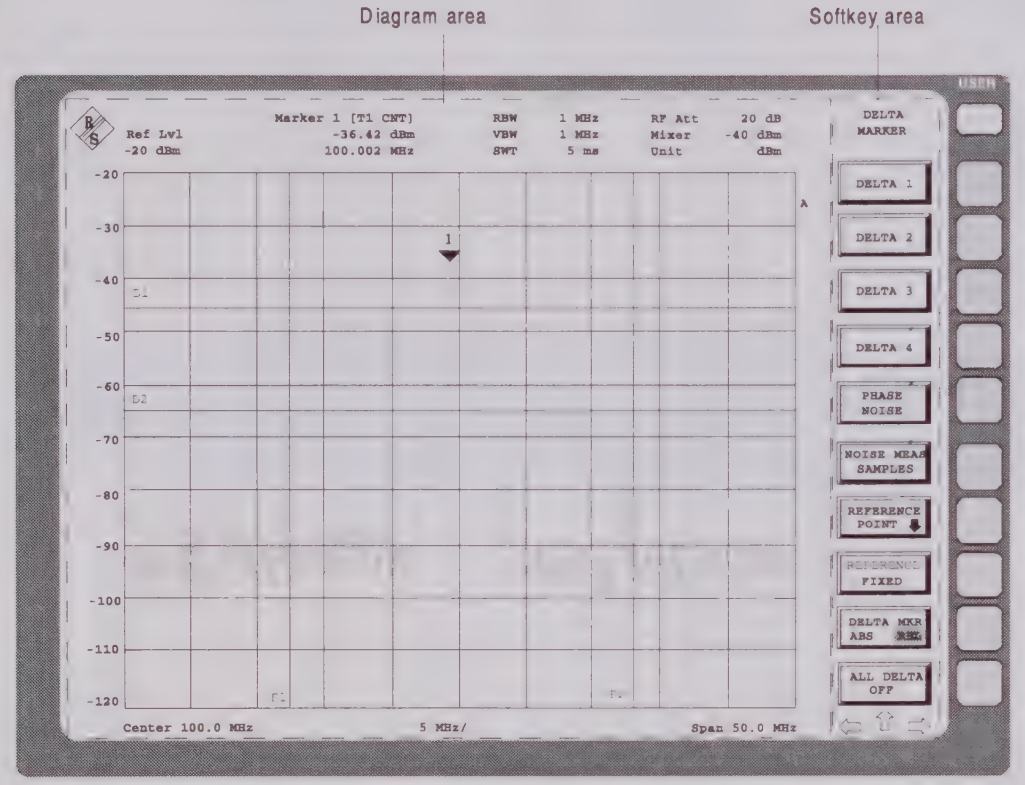


Fig. 2.3-1 Subdivision of screen

Diagram area This area contains the measuring diagrams and other measured-value information as well as the parameters and status information which are important for analysis of the results.
In addition, message fields, entry windows and tables may be shown in this area.

Softkey area This area contains the instrument functions which can be selected via the softkeys. The softkey area is not superimposed by other graphics.

2.3.1.1 Diagram Area

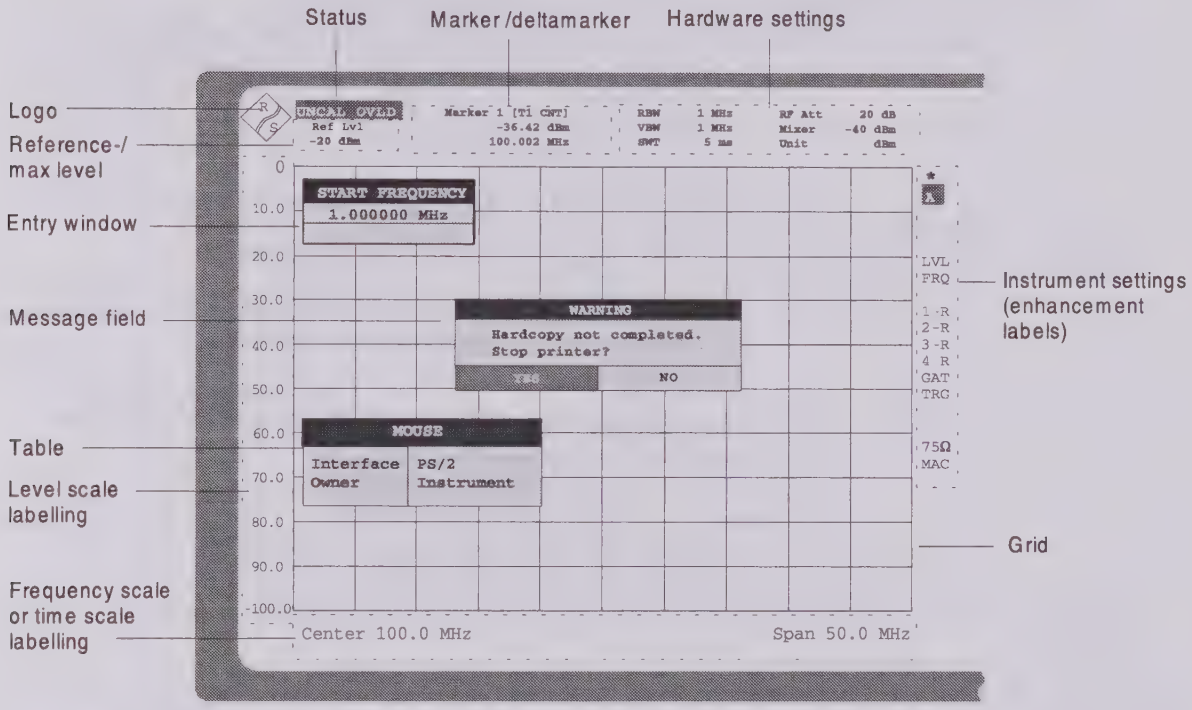


Fig. 2.3-2 Subdivision of the FSE screen in analyzer mode (without measuring diagram)

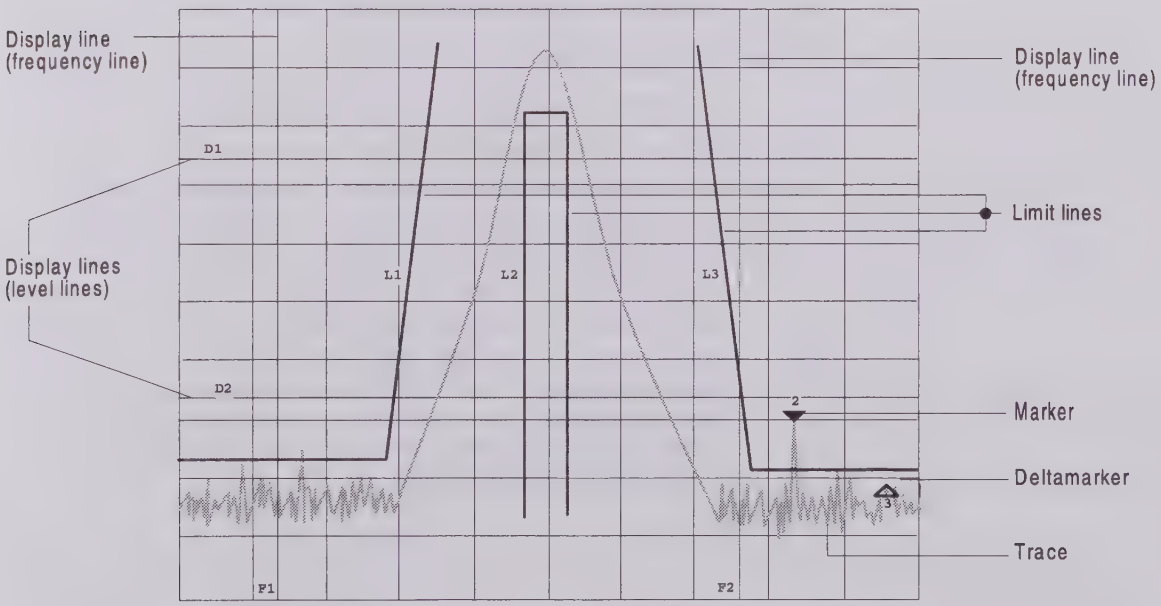


Fig. 2.3-3 Measuring diagram

The following graphic elements are displayed in the diagram area:

Status information Hint at irregularity (e.g. UNCAL)

In addition the status display displays MAX / REF LVL, if the maximum level and the reference level have different values.

UNCAL "UNCAL" is indicated under the following circumstances:

- no valid calibration data (Status CALIBRATION FAILED in table CAL RESULTS), may occur after a cold start following a firmware update
  ⇒ Total calibration
- correction data are switched off (menu CAL, CAL CORR OFF).
  ⇒ switch on CAL CORR ON or PRESET
- Sweep time too short for current instrument settings (span, resolution bandwidth, video band width).
  ⇒ increase sweep time
- resolution bandwidth too small for set symbol rate (option FSE-B7: digital demodulation) .
  ⇒ increase resolution bandwidth

OVLD „Overload" is indicated when the input mixer is overloaded
⇒ Increase input attenuation

IFOVLD „IF Overload" is indicated when overload occurs after the input mixer.
⇒ Increase reference level

DIFOVL „Digital IF Overload" is indicated when the digital resolution filter is overloaded.
⇒ Increase reference level

ExtRef „External Reference" is indicated when the instrument is set to *REFERENCE EXT* (menu *SETUP*), but the reference signal is missing at the rear panel connector.
⇒ Ceck input signal of external reference

LO unl „LO unlock" is indicated when the 1st LO is unlocked (moduleerror).

LO Lvl „LO Level" is indicated when the output level of the 1st LO is too small (module error).

LO LvD „LO Level Digital IF" is indicated when the output level of the oscillator of module Digital IF is too small (module error).

OCXO „OCXO cold" is indicated when the crystal oscillator has not yet reached ist operating temperature. This indication vanishes after a few minutes after switch on.

UNLD „Underload" is indicated when the analyzer is not in ist optimal dynamic range. In this case the measuring accuracy is not optimal. This indication is only output in vector analyzer operating mode only with option FSE-B7
⇒ Decrease reference level

Marker/Deltamarker

This label displays the position of the last selected marker or deltamarker in the x and y-directions and the marker/deltamarker index. As additional information, 2 fields in square brackets are provided which contain the curve which the marker is assigned to and the active measuring function of the marker indicated. The measuring function of the markers in the second field is indicated by the following abbreviations:

CNT frequency counter active

TRK signal track active

NOI noise measurement active

The marker text has the same color as the trace which the marker is assigned to. If, for example, the active marker is assigned to trace 1, and trace 1 is yellow, the marker text will be yellow, too.

Hardware settings

Analyzer mode

RBW Indication of the set resolution bandwidth.

VBW Indication of the set video bandwidth.

SWT Indication of the set sweep time.

RF Att Indication of the set RF attenuation.

Mixer Indication of the user set level at the input mixer (only when level differs from standard settings (= level of the reference level REF LVL).

Unit Indication of the level unit of the measuring results and the associated setting and test parameters in full length. This label is particularly important for selection of units with more than 4 digits, since they can only be indicated as dB* in the other labels (except for marker).

Tracking generator mode Only available with one of the options FSE-B8/9/10/11

TG Lvl Indication of the set output level of the tracking generator

Vector Analyzer mode Only available with option FSE-B7

CF Indication of the set center frequency

SR Indication of the symbol rate

Demod Indication of the switched on demodulator.

Standard Indication of the set standard (e.g. GSM)

DEMOD BW Indication of the demodulation bandwidth for analog demodulation.

Grid

X-axis: frequency or time,
Y-axis: level

Instrument settings (Enhancement Labels)

Indication of user instrument settings which influence the measuring result and which are not immediately obvious when viewing the measured values.

***** The current instrument setting does not correspond to the one which applied when one of the displayed curves had been stored. This occurs under the following circumstances:

- The instrument setting is modified while a sweep is being performed.
- The instrument setting is modified in SINGLE SWEEP mode subsequent to the end of the sweep and no new sweep is started.
- The instrument setting is modified after setting the trace to VIEW.

The display is retained until the cause is eliminated by the user. I.e., either a new sweep is started (SINGLE SWEEP mode), or the trace of interest is switched to BLANK (all cases).

A Identification for screen A. Screen A is activated for the entry of test parameters.

B Identification for screen B. Screen B is activated for the entry of test parameters.

C If, in the Vector Analyzer (Option FSE-B7) mode, the inphase and quadrature signal is displayed in the measurement window A, the window is subdivided into two diagrams. The upper diagram is marked with an A and the bottom one with C.

D If, in the Vector Analyzer (Option FSE-B7) mode, the inphase and quadrature signal is displayed in the measurement window B, the window is subdivided into two diagrams. The upper diagram is marked with an B and the bottom one with D.

LN The automatic setting of the input attenuation is set to ATTEN LOW NOISE.

LD The automatic setting of the input attenuation is set to ATTEN LOW DISTORTION.

NOR Normalization is activated; high accuracy (only with one of the options FSE-B8/9/10/11).

APP Normalization is activated; medium accuracy (only with one of the options FSE-B8/9/10/11).

TDF A antenna correction factor (*TRANSDUCER FACTOR*) is switched on.

TDS A set of antenna correction factors (*TRANSDUCER SETS*) is switched on.

LVL A level offset ≠ 0 dB has been set. A level offset of the installed tracking generator (option) leads to the same display.

FRQ A frequency offset ≠ 0 Hz has been set.

SGL The sweep is set to SINGLE SWEEP.

1-<n> Subtraction Trace 1 - Trace <n> active (<n>: numeric value) or subtraction Trace 1 - Reference Line active (<n>: R)

2-<n> Subtraction Trace 2 - Trace <n> active (<n>: numeric value) or subtraction Trace 1 - Reference Line active (<n>: R)

3-<n> Subtraction Trace 3 - Trace <n> active (<n>: numeric value) or subtraction Trace 1 - Reference Line active (<n>: R)

4-<n> Subtraction Trace 4 - Trace <n> active (<n>: numeric value) or subtraction Trace 1 - Reference Line active (<n>: R)

<n>AP For trace <n> (n = 1 to 4) the detector is set to AUTOPEAK.

<n>MA For trace <n> (n = 1 to 4) the detector is set to MAX PEAK.

<n>MI For trace <n> (n = 1 to 4) the detector is set to MIN PEAK.

<n>SA For trace <n> (n = 1 to 4) the detector is set to SAMPLE..

<n>AV For trace <n> (n = 1 to 4) the detector is set to AVERAGE..

<n>RM For trace <n> (n = 1 to 4) the detector is set to RMS.

GAT The frequency sweep is controlled via the *EXT TRIG/GATE* input of the instrument.

TRG The instrument is not triggered in *FREE RUN* mode.

EXT The unit is configured for operation with external reference

75 Ω The input impedance of the unit is set to 75 Ω.

MAC Macro recording active.

PRN A printer output is active. PRN overwrites the enhancement label MAC.

<n>VIEW Trace <n> (n = 1 to 4) is set to VIEW

<n>AVG Trace <n> (n = 1 to 4) is set AVERAGE

Frequency axis labeling Display of the x-scaling.

123.4 ms/Div

The distance between two grid lines is displayed in this label.

Center 1.2345678901234 GHz

Start 1.2345678901234 GHz

The set center frequency or start frequency is displayed in this label depending on whether the keys CENTER/SPAN or START/STOP were last pressed.
If span = 0 Hz, the center frequency is always displayed.

Span 1.2345678901234 GHz

Stop 1.2345678901234 GHz

Trigger 1.234 ms

The set frequency range (*SPAN*) or the stop frequency is displayed, depending on whether the keys CENTER/SPAN or START/STOP were last pressed.
If span = 0 Hz, the trigger moment (*PRETRIGGER*) is displayed.

Optional labeling Optional indication of date, time and comment.

14.Jun 97 12:13

Level axis labeling	Display of the y-scaling.
Entry window	The data entry window is superimposed in the diagram area, if required.
Reference level/ Max. level	Display of the set reference level or combined display of maximum level and reference level.
Limit lines	Limit lines are used to mark level curves or spectral distributions which must not be exceeded or dropped below.
Traces 1 to 4	Up to 4 traces can be displayed simultaneously.
Display lines	Utilities for trace analysis.

The FSE provides two display modes:

- Full Screen: 1 window, all traces are displayed in one window.
- Split Screen: 2 windows, traces, grid and labels are distributed on the two windows.

2.3.1.2 Split Screen

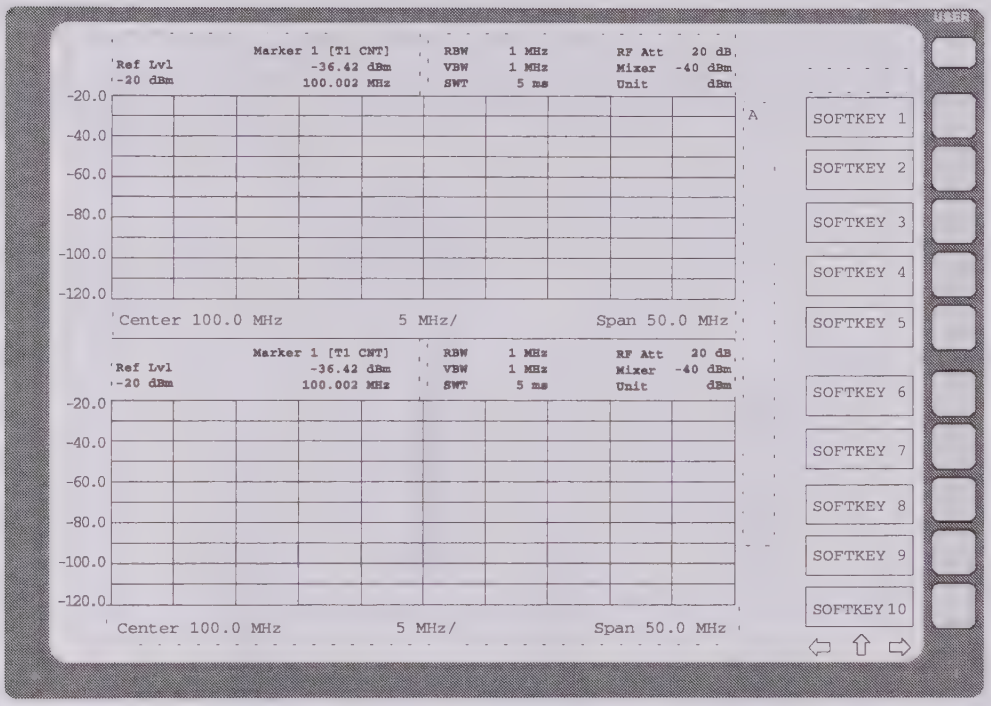


Fig. 2.3-4 Subdivision of the screen in Split Screen mode

In Split Screen mode, the screen is divided into two halves. The upper half is assigned Screen A, the lower one Screen B. The settings for measurement can be selected independently for both screens. E.g., a spectrum may be displayed in Screen A and a time amplitude in the time range is displayed in Screen B. The window for entry of the measuring parameters or the marker operation is selected using the *DISPLAY* key.

The assignment of traces to the windows is fixed and cannot be modified.

Table 2.3-1 Assignment of traces to windows with split screen

Trace 1:	upper (screen A)
Trace 2:	lower (screen B)
Trace 3:	upper (screen A)
Trace 4:	lower (screen B)

The two windows can be subdivided into two measurement diagrams. This applies to separate display of measurement values, eg to the display of the inphase and quadrature signal in vector analysis. Screen A is divided into diagrams A and C, screen B is divided in diagrams B and D.

2.3.1.3 Softkey Area

The setup of the softkey area is independent of the operating mode. It consists of the following graphic elements:

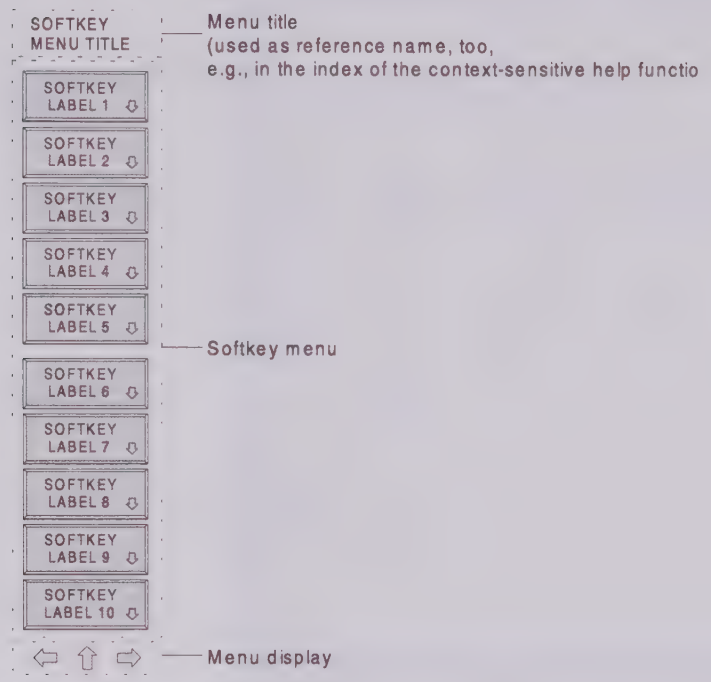


Fig. 2.3-5 Setup of the softkey area

The softkeys have different functions depending on the instrument state. Therefore, their labeling can be varied. The function and current state of the softkeys is indicated in the label by different texts and colors. The color assignment is factory-set as follows:

Table 2.3-2 Factory-set color assignment of soft keys

Softkey color	Meaning
gray	Softkey switched off
green	Softkey switched on
red	Softkey switched on and data entry active

These colors can be changed by the user as desired.
A softkey is switched on or off by pressing the respective hardkey. If a mouse is connected to the instrument, the softkey label on the display can be selected using the mouse, alternatively.

If instrument functions depend on **options**, the associated softkeys may be completely masked out, if the options are not fitted. If instrument functions are not available temporarily due to different **operating modes,** the corresponding softkeys are disabled. Actuating the softkey has no function then. In this case, the softkey is represented "plane", i.e., without 3D effect.

2.3.2 Changing the Menu

With manual control, the FSE can be operated via the front-panel keys, the external keyboard or with a mouse.

Operation is menu-controlled. Various **softkey menus** are displayed depending on the instrument status. The individual menus constitute the so-called menu tree. The top menu (the root of the menu tree) is always called by means of a keystroke. The individual softkeys are then used to branch into further menus (submenus).

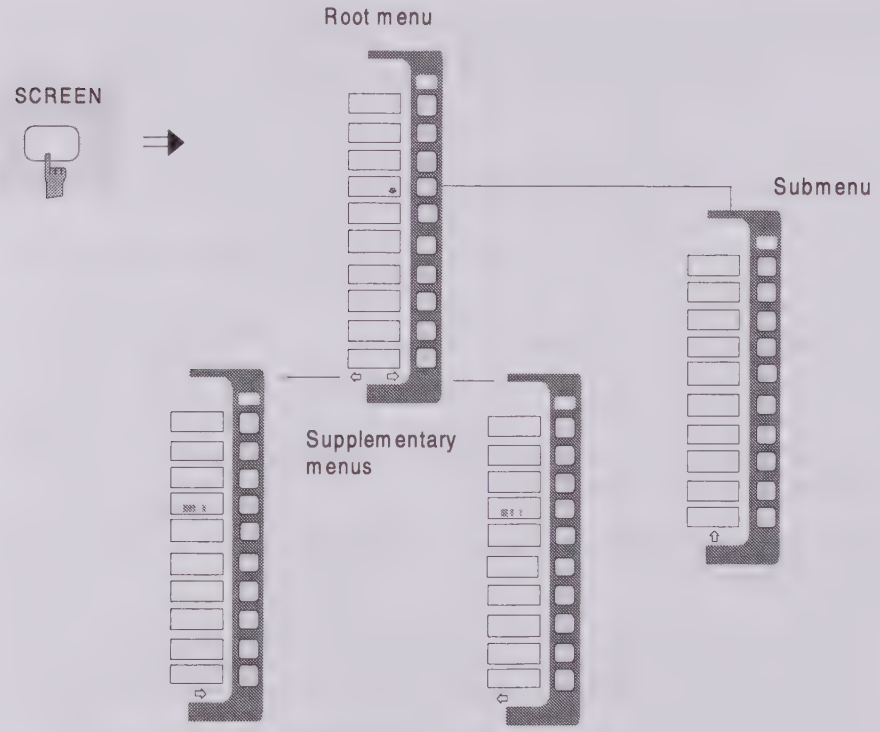


Fig. 2.3-6 Theory of menu selection

Each softkey menu consists of max. 30 softkeys, 10 softkeys being arranged in a main menu, 10 in a left-hand supplementary menu and 10 in a right-hand supplementary menu. In contrast to empty main menus, empty supplementary menus are not displayed. Arrows at the lower edge of the softkey area indicate whether a supplementary menu exists or not.

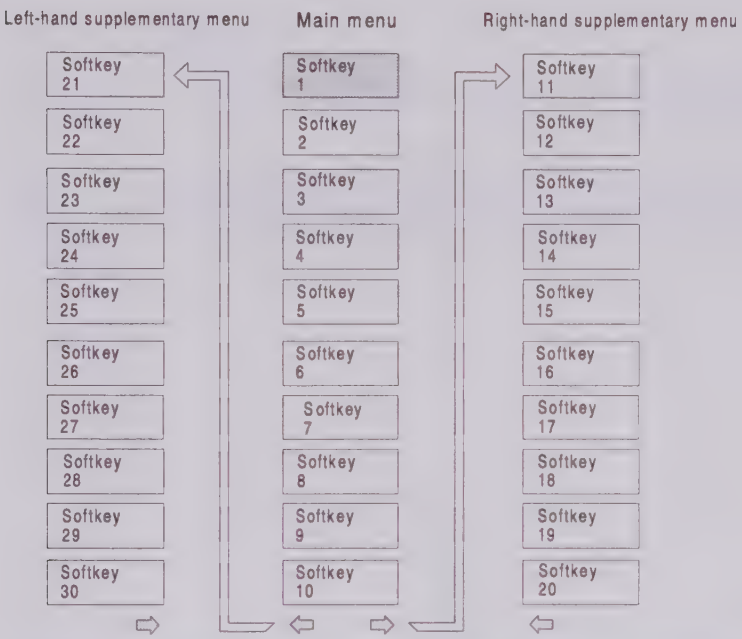


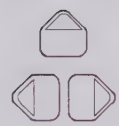
Fig. 2.3-7 Switching between main menu and supplementary menu

The menu arrows help to orient inside the menu tree.

Examples: ⇦ ⇨ This menu has a right-hand and a lefthand supplementary menu. It is the root menu since there is no ⇑ arrow.

⇧ ⇨ Only a right-hand supplementary menu or the upper menu can be accessed from this menu.

MENU



The MENU keys allow for selecting the main menu and the supplementary menus. If a mouse is connected to the instrument, the menu arrows can be selected to enter the respective menus. The MENU keys have the following functions:

When this key is pressed, the FSE enters the left-hand supplementary menu.

This key is pressed to call the upper menu which is located in the next higher hierarchical level in the menu tree. Several menus provide for automatic change, i.e., return to the next higher menu is caused automatically after pressing a softkey.

The right-hand supplementary menu is selected by pressing this key.
A supplementary menu cannot be selected from another supplementary menu but only via the main menu.

The labelling of all softkeys which call a submenu includes an arrow. Selection of a submenu is always effected via a softkey.

The softkeys are masked out in remote mode and during macro processing.

2.3.3 Setting the Parameters

2.3.3.1 Data Entry

Instrument parameters can be entered in an entry window or in a table via the numeric keypad on the front panel (*DATA ENTRY*), an external keyboard and the roll-key.
The numeric keypad *DATA ENTRY* is provided for entry of numeric parameters (e.g., the start frequency). The roll-key is used for fast incrementing or decrementing of numeric parameters with a defined step size.

It is advisable to use the external keyboard for definition of alphanumeric parameters (e.g., file names) since the front panel does not allow for entry of letters. If no external keyboard is provided, the help line editor is called automatically for entry of alphanumeric parameters.

2.3.3.1.1 Numeric Keypad on the Front Panel

The keys are assigned the following functions:

DATA ENTRY

Number keys

DATA ENTRY

Changes the sign of the mantissa or exponent of a numeric parameter. A "-" is inserted at the cursor position in case of an alphanumeric parameter.

DATA ENTRY

Inserts a decimal point "." at the cursor position in the numeric string.

DATA ENTRY

Provide the numeric value entered with the selected unit and terminate the entry.

The unit keys are all assigned the value "1" if quantities are indicated without dimensions in order to prevent faulty operations The unit keys thus adopt the function of an ENTER key. The same applies for an alphanumeric entry field.

Adds an exponent (E-xx) to the end of the numeric string.

Deletes the character left to the cursor with numeric entry.
After entry has been terminated it allows for toggling between the current parameter and the previous value (UNDO function).

Exit from the entry window and removal from screen prior or subsequent to entry.
Complete deletion of the entry string just being entered during numeric entry.
Deletion of the system messages or warnings which are displayed in an individual field.

2.3.3.1.2 Roll-key and Cursor Keys

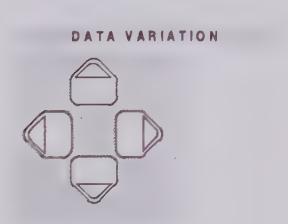
The roll-key has various functions.

- With numeric entry, the instrument parameter is incremented (turning clockwise) or decremented (turning counterclockwise) at a defined step size.

  The step size may be equal to or smaller (e.g., 1/10) than the step size being defined for the cursor keys (see description of the *STEP* key).
- In tables, the roll-key can be used to shift the cursor horizontally or vertically when no entry window is open. The direction (horizontal/ vertical) is switched over using the cursor keys.
- The roll-key is used with the help-line editor to select the individual letters.
- It can be used to shift markers, display lines, limit lines etc.

The roll-key provides an acceleration algorithm, i.e., the variation step size increases with increasing rotational speed.

Cursor keys:



With numeric entry, the keys ⏶ or ⏷ are used to increase or decrease the instrument parameter by the selected step size. The keys are disabled With alphanumeric entry, the keys are used to toggle between the editing line and the help line editor.

The keys ⏴ and ⏵ are used to shift the cursor inside the entry window to reach a particular position in the number string.

In tables, the cursor keys are used to shift the cursor between the lines and columns of the table.

2.3.3.2 Entry Windows

2.3.3.2.1 Setting Up the Entry Window

The instrument parameters are not entered at the location where the parameter is displayed but in an individual entry window.

The entry window is called by a softkey or a hardkey and is used for definition of numeric or alphanumeric instrument parameters (START FREQUENCY by way of example):

START FREQUENCY
10.2457535 GHZ
START FREQUENCY OUT OF RANGE
Headline with parameter designation
Editing line with parameter value and unit
Status and error messages

Fig. 2.3-8 Setup of an entry window

Subsequent to calling the entry window the current parameter value including the unit is displayed in the editing line. Status and error messges which refer to the current entry are displayed in the third and (optionally) fourth line.

The entry window is displayed in the left upper edge of the active measuring window with the default setting. When a mouse is connected to the instrument, open entry windows can be shifted to any position on the screen provided that they do not cover the softkey line. The new position is valid until measuring window is selected. The data entry window is represented transparent or non-transparent, as required.

Alphanumeric parameters are displayed as a simple character string in the editing line. Numeric parameters which consist of mantissa, exponent and unit are set up as follows:

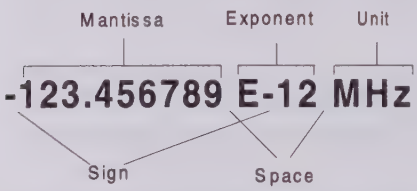


Fig. 2.3-9 Setup of numeric parameters

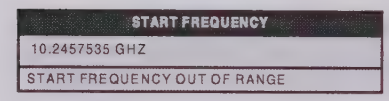
Mantissa: The first character is the sign of the mantissa, the positive sign is not displayed. The actual numeric value follows. The number of digits depends on the instrument parameter. The cursor may be shifted to the first digit of the mantissa at maximum, however, it may not precede the sign. The decimal point can be set as required.

Exponent: The exponent is separated from mantissa by a space character. The sign field of the exponent follows the "E", the positive sign "+" being not displayed similar to the representation of the mantissa. The cursor skips the "E" and the sign field. Two characters are fixed for the exponent value.

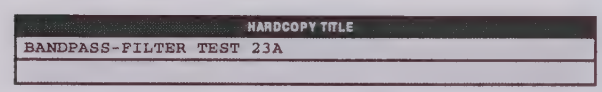
Unit: The unit (not represented in editing mode) is separated from the exponent by a space character.

The number of digits which can be entered for each instrument parameter is limited by the width of the input field only, but not by the amount which is physically enabled. (Example: Levels should be indicated with two decimals. The user may, however, enter as many decimals as desired - the entered value is rounded accordingly).

There are two types of entry windows:



The editing line of the entry window for numeric parameters allows for display of up to 24 characters. Horizontal scrolling is not possible in the editing line.



The editing line of the entry window for alphanumeric parameters allows for display of up to 60 characters (cf. display section). Maximum 256 characters may be entered. Horizontal scrolling is possible.
If no external keyboard is provided, the three-line entry window is replaced by a letter field which allows for individual selection of characters using the cursor keys (see help line editor)

2.3.3.2.2 Editing of Numeric Parameters

Calling the entry window:

- Subsequent to calling the entry window, the current value of the numeric parameter including the unit is displayed in inverted color. The cursor is not displayed in this state. The transparent data entry window has no background color.
- The entry window is closed upon pressing the key CLR.

Editing mode:

- Pressing a number, sign or decimal point key causes the value and unit to be deleted. The new value is output left-justified. The individual characters are entered in insert mode. If the maximum amount of characters for the mantissa or the exponent has been entered, no further entry is possible (no horizontal scrolling). If characters are positioned to the right of the cursor, they are shifted right when reaching the maximum length and get lost.
- Pressing the keys DATA VARIATION ◁ or ▷ causes normal representation of the current value. The unit is no longer displayed and the cursor precedes the first digit of the mantissa (◁) or follows the last digit entered (▷). The DATA VARIATION keys ◁ and ▷ change the numeric value of the cursor.
- Pressing the DATA VARIATION keys △ or ▽ or the roll-key causes the original parameter value to be restored and modified according to the defined step size for this parameter.
- The data management of the instrument stores the previous value of a parameter in addition to the current value. The BACK key allows for toggling between these two values.

Termination and abortion of entry:

- The editing mode is terminated by pressing a unit key. The validity of the new parameter value is checked and accepted for the instrument setting. If an error occurs, a corresponding error message is displayed in the status line of the editing field, e.g., *"Out of range"*, *"Value adjusted"*, etc.
- Editing of a parameter can be aborted by pressing the key CLR. The original parameter is then displayed again. The entry window is closed by pressing the CLR key again.
- Pressing a key or softkey subsequent to starting the entry causes the entry to be aborted and the entry window to be closed. If the same softkey which has opened the entry window is activated during entry, the original value is restored and displayed.

2.3.3.2.3 Editing of Alphanumeric Parameters

Generally, the regulations for numeric parameters analogously apply for alphanumeric parameters. Note the exceptions given below:

- Alphanumeric parameters are not displayed with a unit.
- The four unit keys adopt the function of the ENTER key.
- Horizontal scrolling is possible in the editing line.
- Incrementing or decrementing cannot be effected via the keys ⏶, ⏷ or the roll-key.
- Pressing the sign key causes a "-" character to be inserted at the cursor position, the decimal point key causes insertion of a point ".".
- The exponent key has no function.

2.3.3.2.4 Help Line Editor

The help line editor allows for labelling or text entries to be made without an external keyboard being required. In this case, a field containing letters and special characters is added to the standard entry window. The help line editor is displayed automatically if no external keyboard is provided and an entry window for alphanumeric entry is opened.

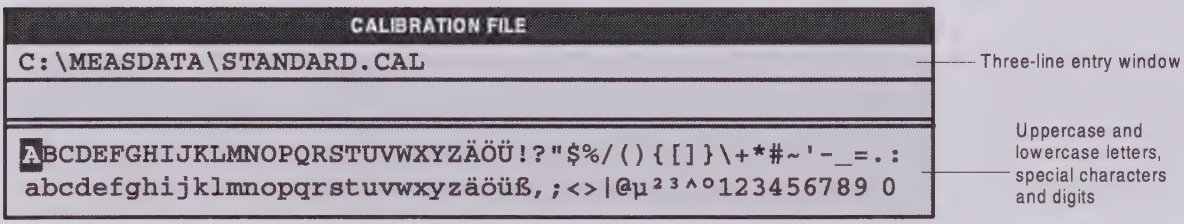


Fig. 2.3-10 Help line editor

- The keys ⏶ and ⏷ are used to toggle between the editing line and the help line editor.
- The cursor can be positioned to the required character in the help line editor using the cursor keys and the roll-key.
- A character is entered in the editing line by pressing any of the unit keys.
- If the cursor is already located in the editing line, pressing a unit key terminates data entry.

2.3.3.3 Table Entry

The FSE uses numerous tables for indication and configuration of instrument parameters. The tables differ very much in the number of lines, columns and inscriptions and have a different functionality.

Tables are represented in a non-transparent form. The size is predefined and cannot be modified. If a mouse is connected, the tables may be shifted on the display without covering the softkeys. Tables can be superimposed by entry windows or suchlike.

Tables are mostly coupled to a softkey menu which provides further functions for editing table entries, e.g., deletion of tables, copying lines or columns, marking of table elements, restoring of default states etc. Another kind of tables is exclusively used for indication of instrument parameters and cannot be edited.

The definition of individual tables and the operation of particular editing functions can be looked up in the reference section with the description of the corresponding softkey menu.

The basic concept of operation is, however, the same for all tables. A differentiation is made between shifting mode and editing mode.

2.3.3.3.1 Shifting Mode

This mode is active subsequent to opening a table. The **cursor** is shifted between the table elements by means of the cursor keys. The table element which is below the cursor is represented in inverted color.

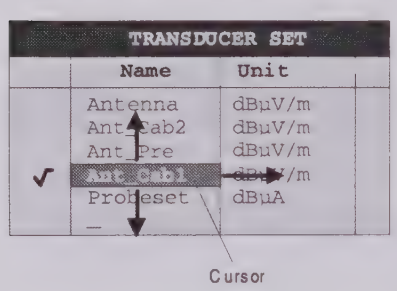


Fig. 2.3-11 Shifting mode

2.3.3.3.2 Editing Mode

A table element which is marked by a cursor can be editied as follows:

- by pressing one of the unit keys on the front panel or the *ENTER* key on the external keyboard.
- by a double-click of the mouse on the table element. If the clicked element is not yet marked by the cursor, the letter is positioned on the element, additionally.
- For numeric or alphanumeric instrument parameters, the editing operation may be started by entry of any number or letter on the front panel or on the external keyboard.

The data entry window, the selection list or the toggle editor are provided for this purpose.

After the editing operation has been terminated, the table enters the shifting mode again. The cursor is positioned automatically on the next table element.

2.3.4 Disabling the Control Elements - HOLD Key

The individual softkeys have the following functions:

DATA VARIATION

The functions of the *HOLD* menu allow for disabling individual control elements or the complete instrument control. The LED above the *HOLD* key indicates that either the function *LOCK DATA* or *LOCK ALL* has been activated. The control can be enabled again by successively pressing the two *UNLOCK* softkeys in any order.

Switching off the instrument resets control such that the instrument can be normally operated again after subsequent switch-on.

After selecting the two UNLOCK soft keys, the instrument keyboard is enabled again. The LED above the HOLD key goes out.

Selection of soft key *LOCK DATA* causes the roll-key on the front panel and the keys and on the front panel and external keyboard to be disabled in order to prevent a parameter from being varied by mistake.

Selection of *LOCK ALL* soft key disables the complete front panel (including the *PRESET* key and roll-key, not including the *UNLOCK* softkeys), the mouse and all keys of the external keyboard. Exit from the *HOLD* menu is no longer possible. Control is enabled again by actuating the two *UNLOCK* softkeys.

2.3.5 Setting the Stepsize - STEP Key

A number of numeric instrument parameters allow for step-by-step incrementing or decrementing the value in the editing line of the entry window using the keys ⏶ or ⏷ or the roll-key. The stepsize used with the cursor keys can be specified for the selected parameters in the *STEP* menu.

Notes: – *It is not possible to set the stepsize by all of the numeric parameters.*
– *An extended STEP menu is available by some parameters. The extra functions are described by the respective parameter.*
– *Setting the step size has no effect on the roll-key (the resolution of the roll-key is higher than that of the step size functuion)*

DATA VARIATION

The *STEP* key opens the *STEP* menu for entry of the stepsize.

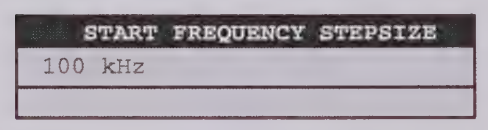
The stepsize of an instrument parameter can only be varied when this parameter is edited in an entry window.
The soft keys in the *STEP* menu are disabled if no instrumentnparameter is being varied or if the parameter being edited does not support stepsize variation (as is the case by all of the alphanumeric parameters.

The key ⏶ leads to exit from the *STEP* menu and automatic return to the previously active menu.

The softkey *STEPSIZE AUTO* causes the stepsize for the corresponding instrument parameter to be set automatically and be continuously varied with varying instrument settings (in accordance with other parameters).

Example:
The stepsize of the *CENTER* frequency depends on the selected span.

The softkey *STEPSIZE NORMAL* calls an entry window for definition of a stepsize by the user. The parameter whose stepsize is varied, is displayed in the headline of the entry window:



The stepsize remains constant until a new value is entered or until the STEPSIZE AUTO soft key is activated. It is no longer coupled to other instrument parameters.

2.3.6 Mouse and External Keyboard Control

2.3.6.1 External Keyboard Control

The connection of an external keyboard provides additional characters for the entry (letters and special characters). It is permitted to use both, front panel keys and the external keyboard, for control. The number, cursor and sign keys have the same effect as the corresponding front panel keys. A few keys of the external keyboard provide an extended functionality with entries or tables which is described in the Appendix E.

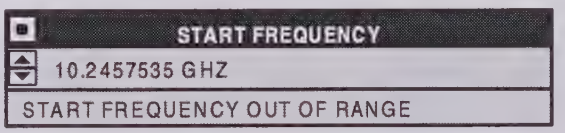
2.3.6.2 Data Entry Windows with Mouse Control

With a mouse being connected, additional functions are provided in the entry windows. Therefore, buttons are displayed in the entry window.

Essentially, the definitions which have been made for all types of entry window also apply for mouse control. However, note the following deviations:

- The so-called close-button is displayed on the left margin of the headline. Selecting this button via the mouse aborts the entry and closes the entry window. This corresponds to the function of the CLR key with manual control.
- In the numeric entry window, two buttons ( ) are displayed on the left margin of the editing line. Simply clicking the buttons causes the parameter in the editing line to be incremented or decremented (similar to the keys / or the roll-key with manual control).
- The cursor can be positioned in the entry line by clicking a character using the mouse.
- A character in the letter window of the help line editor can be selected by a single click. A double click copies the character from the letter window into the editing line.
- Open entry windows can be shifted across the complete screen using the mouse; they must not, however, be superimposed on the softkey line. Shifting is performed by clicking the headline and pushing the mouse while he mouse-key is being pressed.

Example: Numeric entry window with mouse control



2.3.6.3 Mouse Control of Further Display Elements

To increase operating ease, all display and control elements (enhancement labels, softkeys, function labels, etc.), which are indicated on the instrument, can be mouse-controlled.

Double-klicking an display or control element opens the corresponding soft key menu. The assignment of soft keys/keys to display elements is shown in appendix E.

Klicking the right mouse key call all soft key menus one after the other.

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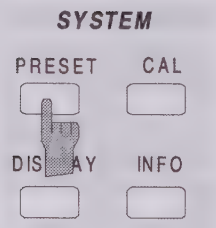
2.4 General Configuration – *SYSTEM* and *CONFIGURATION* Key Groups

2.4.1 FSE Initial Configuration – *PRESET* Key



Using the *PRESET* key, the FSE can be brought to a predefined initial state equivalent to the state after power on. All previous setting are deleted if they were not previously saved in memory. Returning to the *PRESET* state is not critical with regard to an arbitrary signal which may still be present at the input as long as the signal is within the specified voltage range.

Note: *The initial state set by the PRESET key can be adapted to arbitrary applications using the AUTO RECALL function. This function implies that the AUTO RECALL dataset is loaded upon pressing the PRESET key. For further information refer to section 2.7.3.*

Pressing the *PRESET* key, causes the FSE to enter its initial state according to the following table:

Table 2.4-1 Initial State of FSE

Parameter	Setting				
	FSEA	**FSEB**	**FSEM**	**FSEK**	
Mode	analyzer	analyzer	analyzer	analyzer	
Center Frequency	1,75 GHz	3,5 GHz	13,25 GHz	20 GHz	
Center Frequency Step Width	350 MHz	700 MHz	2,65 GHz	4GHz	auto, 0.1×Span
Span	3,5 GHz	7 GHz	26,5 GHz	40 GHz	
RF Attenuation	10 dB	10 dB	10 dB	10 dB	auto
Ref Level	-20 dBm	-20 dBm	-20 dBm	- 20 dBm	
Level Range	100 dB log	100 dB log	100 dB log	100 dB log	
Detector	auto peak	auto peak	auto peak	auto peak	
Sweep Time	5 ms	5 ms	150 ms	225 ms	auto
Res BW	3 MHz	3 MHz	3 MHz	3 MHz	auto
Video BW	3 MHz	3 MHz	3 MHz	3 MHz	auto
Sweep	cont	cont	cont	cont	
Trigger	free run	free run	free run	free run	
Trace	1	1	1	1	clr write
Trace	2, 3, 4	2, 3, 4	2, 3, 4	2, 3, 4	blnk

2.4.2 Display Configuration – *DISPLAY Key*

The display of the measurement results on the FSE display screen takes place in either one or two measurement windows. In some cases, the two windows can be subdivided into two diagrams each, e. g. for the representation of the inphase and quadrature signal in the vector analyzer mode.

If only one window is used, this window fills the complete display screen. Two measurement windows are always placed over each other. The axes labelling and measurement settings are defined independently in each measurement window.

When two measurement windows are used, the settings can be chosen to be either coupled or fully independent from each other. The measurement procedure is always sequential.

New instrument settings can only be entered in the active measurement window. This window is marked on the upper right corner of the grid. Coupled settings are changed simultaneously in both windows at the time of entry.

The entry of the measurement parameters for each of the two windows can be either independent from one another using numerical inputs, or by graphical definition of the span through the use of level and frequency lines. The former case, e.g., may be used for harmonic or frequency converter measurements, and the latter case, for a zoom display of a frequency or level segment.

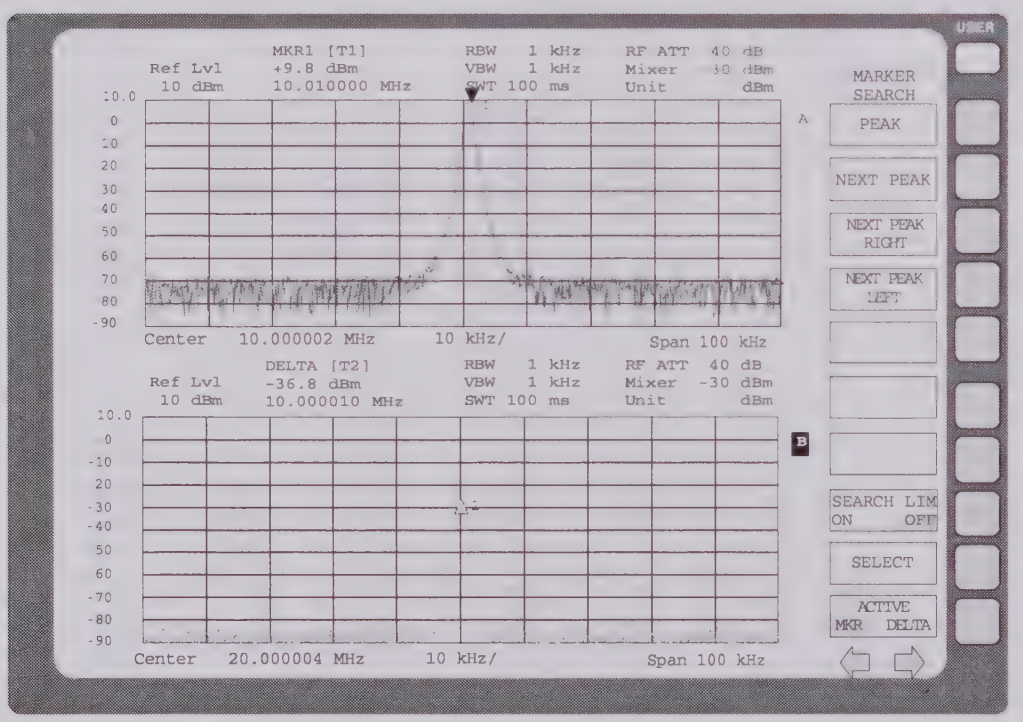
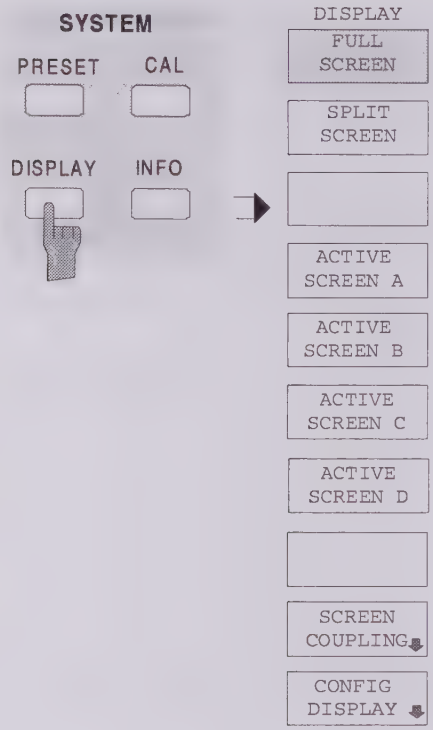


Figure 2.4-1 Split screen mode, screens uncoupled

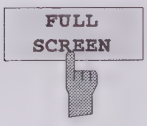
SYSTEM DISPLAY menu:



The *DISPLAY* key calls a menu which is used to configure the display screen and to select the active measurement window in SPLIT-SCREEN mode.

2.4.2.1 Display Screen Mode Selection

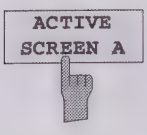
SYSTEM DISPLAY menu:



The *FULL SCREEN* soft key configures the display screen to one measurement window. This is the default setting of the FSE.

In this mode, the *ACTIVE SCREEN A / ACTIVE SCREEN B* and *SCREEN COUPLING* soft keys are not used.

The *SPLIT SCREEN* soft key sets the display screen to show two measurement windows. The upper window is called *SCREEN A*, the lower is called *SCREEN B*.



If *SPLIT SCREEN* display is activated, the *ACTIVE SCREEN A* and *ACTIVE SCREEN B* soft keys are used to activate either window A or window B.

The entry of new settings is only possible for the active window.

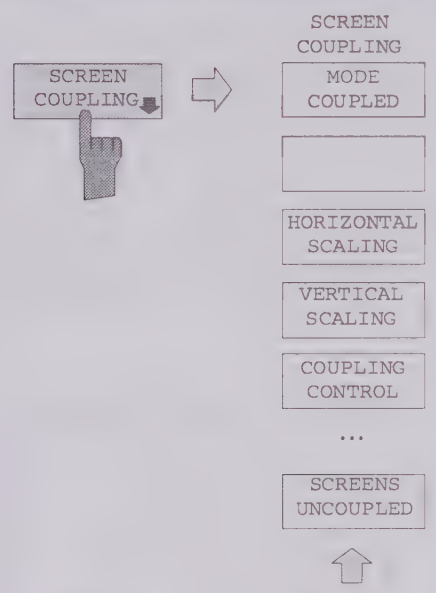
When switching back to FULL SCREEN mode, the active measurement window is displayed.

If, in addition, the two windows are both subdivided into two diagrams, the *ACTIVE SCREEN A/B* softkeys activate the upper diagram, *ACTIVE SCREEN C/D* the lower diagram in each window.

2.4.2.2 Measurement Window Coupling

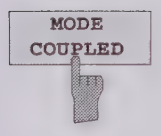
For the most part, the settings for the two windows can be either independently performed or coupled to one another. In many cases, when changes are made in one window (e.g., the reference level) it is desirable to also make the corresponding changes in the second window. The measurement window parameters which are to be coupled may be selected in the *SCREEN COUPLING* menu.

SYSTEM DISPLAY-SCREEN COUPLING submenu:

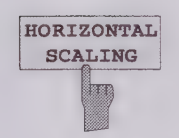


The *SCREEN COUPLING* soft key calls a sub-menu in which the coupling between the two measurement windows *SCREEN A* and *SCREEN B* can be defined. This coupling is only effective when both windows are displayed (*SPLIT SCREEN*).

In the default setting, all of the items which are selectable are also coupled.



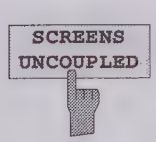
The *MODE COUPLED* soft key switches the coupling of the operating mode (Analyzer, Receiver, Vector Analyzer) on/off.



The *HORIZONTAL SCALING* soft key switches the coupled scaling of the horizontal axes on and off. In the frequency domain, the center frequency and the frequency span are identical. In the time domain, the sweep time for both windows is the same.

The *VERTICAL SCALING* soft key switches the coupled scaling of the vertical axes on and off. For a level measurement, this means that the reference level and the vertical resolution (*LEVEL RANGE*) are set to the same values in both windows.

The *COUPLING CONTROL* soft key switches the coupling of the trigger and gate parameters and of SWEEP COUNT and SWEEP SINGLE/ CONTINOUS on/off.



The *SCREENS UNCOUPLED* soft key switches all of the possible couplings between the measurement windows to off.

2.4.2.3 Display Screen Configuration

SYSTEM DISPLAY-CONFIG DISPLAY submenu:

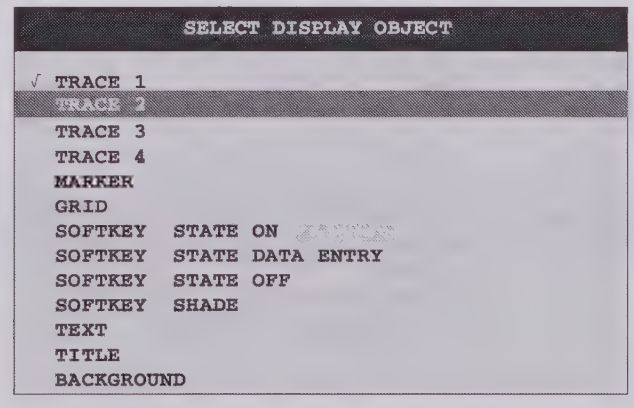
The *CONFIG DISPLAY* soft key calls a submenu and its supplementary menu, in which the selection of color and brightness for the individual elements on the display screen takes place. The actual selection of the elements takes place in the corresponding menu table.

The color assignment of the soft keys is coupled with the color assignment of other display elements.

Changing for example the color of SOFTKEY STATE OFF causes the color of the table background to be changed at the same time. The same applies to SOFTKEY STATE DATA ENTRY and display lines, and to SOFTKEY STATE ON and enhancement labels.

In the supplementary menu, date, time and a diagram label can be displayed on the screen.

The *SELECT OBJECT* soft key activates the SELECT DISPLAY OBJECT table, with which a graphics element can be selected. After selection, the brightness, tint and saturation of the selected element can be changed using the soft keys of the same name. The color changes can be seen immediately on the display screen.



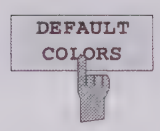
The *BRIGHTNESS* soft key activates the entry of the brightness of the color for the selected element. The range of input values is 0 to 100%.

The *TINT* soft key activates the entry of the color tint of the selected element. The entered value is related to a continuous color spectrum ranging from red (0%) to blue (100%).

The *TINT* function is not available for monochrome (black/white) displays.

The *SATURATION* soft key activates the entry of the color saturation for the selected element.

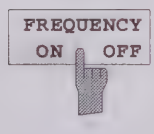
The range of inputs is from 0 to 100%.



The *DEFAULT COLORS* soft key restores the default settings for brightness, color tint and color saturation for all display screen elements.

The *PREDEFINED COLORS* soft key activates a table, with which the predefined colors for the diplay screen elements can be selected.

The *LOGO* soft key switches the Rohde & Schwarz company logo displayed in the upper left corner of the display screen on or off.



The *FREQUENCY* soft key switches the displaying of frequency information on the screen on and off.

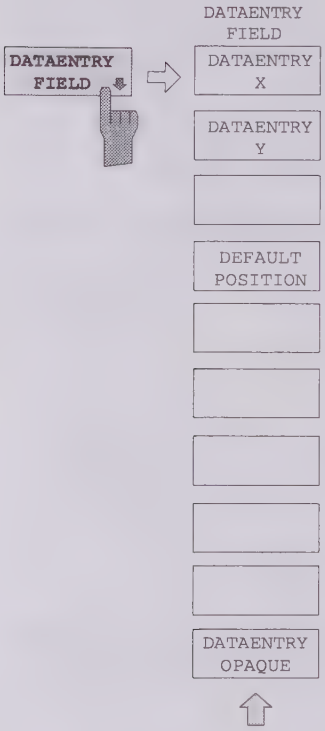
ON Frequency information is displayed.

OFF Frequency information is not outputted to the display. This can be used for example to protect confidential data.

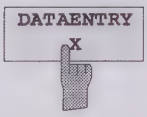
The *TIME* soft key switches on or off the display of date and time at the lower edge of the diagram.

The *DISPLAY COMMENT* soft key activates the entry of a label comprising a maximum of 50 characters. This label is displayed at the lower edge of the diagram.
Pressing the soft key again causes the label to be switched off. The stored text, however, is not deleted.

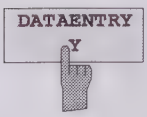
SYSTEM DISPLAY-CONFIG DISPLAY DATAENTRY FIELD Untermenü:



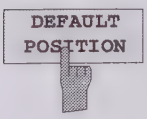
The *DATAENTRY FIELD* soft key displays a submenu used to specify the position and characteristics of the data entry field.



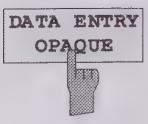
The *DATA ENTRY X* soft key shifts the position of the data entry field horizontally.



The *DATA ENTRY Y* soft key shifts the position of the data entry field vertically.



The *DEFAULT POSITION* soft key positions the data entry field automatically. In general, its position is the upper left edge of the grid on the active screen.



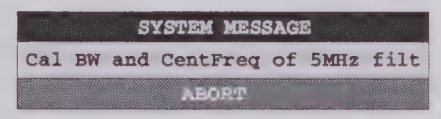
The *DATA ENTRY OPAQUE* soft key sets the data entry windows to opaque. This means that entry windows are underlayed with the background color for tables and that diagrams and traces behind an entry window can no longer be seen.

2.4.3 FSE Calibration – *CAL Key*

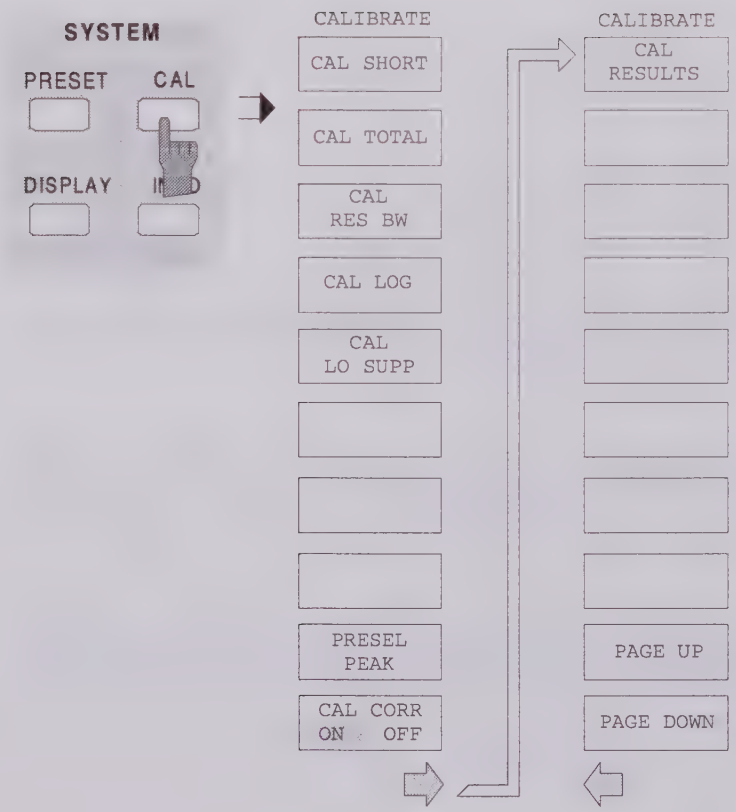
The FSE maintains its high measurement accuracy through the application of numerous self-calibration techniques. The *CAL* hard key provides a series of calibration functions which allow not only the calibration of the complete instrument, but also calibration functions which are specifically applicable to the measurement requirements of relevant instrument sections.

The measurement settings of the FSE are saved and, after calibration, completely restored. The calibration data valid before calibration are saved and, in case of a calibration abort, restored.

A window shows the progress of the calibration while it is running. ABORT can be used to abort the calibration at any time.



SYSTEM CAL menu:



The *CAL* key displays a menu with the available calibration functions.

2.4.3.1 Calibration Function Calls

SYSTEM CAL menu:

The *CAL SHORT* soft key starts a short calibration, in which the absolute gain of the analyzer as well as the gain errors of the selected bandwidth are corrected.

The *CAL TOTAL* soft key starts a complete calibration of the analyzer including additional partial calibrations shown in the menu.

UNCAL is displayed in the status line if calibration cannot be successfully completed or if the correction data are disabled (*CAL CORR* soft key= *OFF*).

The *CAL RES BW* soft key starts the correction of the center frequency, the bandwidth and the gain of the resolution filter.

The *CAL LOG* softkey starts the calibration of the linearity of the logarithmic amplifier.

The *CAL LO SUPP* softkey calibrates the compensation of the first oscillator at low frequencies. After calibration, the display of the internal oscillator at the frequency 0 Hz is very small.

It is recommended that the calibration be performed whenever sensitive measurements are to be made at low frequencies.

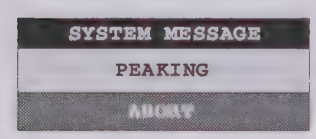
The softkey is only available on model 30 of FSE and in conjunction with option FSE-B7.

The *PRESEL PEAK* softkey optimizes the tuning of the preselector for input signals in the frequency range above 7 GHz.

This calibration should be used whenever signal levels in the frequency range above 7 GHz are to be measured and high accuracy is desired.

If a marker is not active when the *PRESEL PEAK* softkey is pressed, marker 1 is activated as the reference marker and placed on the signal maximum in the active trace. Otherwise the active marker is used.

The following window is displayed on the screen while the peaking function is running. The function can be aborted at any time using the *ABORT* line. In this case, the correction value determined at the factory is restored.



The input signal's signal-to-noise ratio must be at least 10dB in order that the peaking function runs properly. Otherwise, the preselector may be set incorrectly, which would cause level errors by subsequent measurements.

If the instrument setting (start/stop frequency, sweep time) is changed after *PRESEL PEAK* has been called, the correction value for the preselector determined by the function is no longer used. Instead, the correction value determined at the factory is restored.

The softkey is only available by those FSE models which have an input frequency range above 7 GHz.

The *CAL CORR ON/OFF* soft key switches the calibration data on/off.

ON The status message depends upon the results of the total calibration

OFF The message *UNCAL* appears in the FSE status line.

2.4.3.2 Calibration Results

SYSTEM CAL menu:

The *CAL RESULTS* soft key in the right-hand supplementary menu calls the *CALIBRATION RESULTS* table, which shows the correction data found during calibration.

The *CALIBRATION RESULTS* table contains the following information:

page 1:

- date and time of the last total calibration
- overall results of the total calibration
- list of the calibration procedures according to function/module, including the correction values, the measured results and the individual results for each of the calibration procedures

The results for the individual calibration procedures are categorised and displayed as follows:

PASSED	calibration successful without restrictions
CHECK	deviations larger than expected, however, corrections could be performed
FAILED	deviations too large, no corrections were possible
ABORTED	calibration aborted

CALIBRATION RESULTS

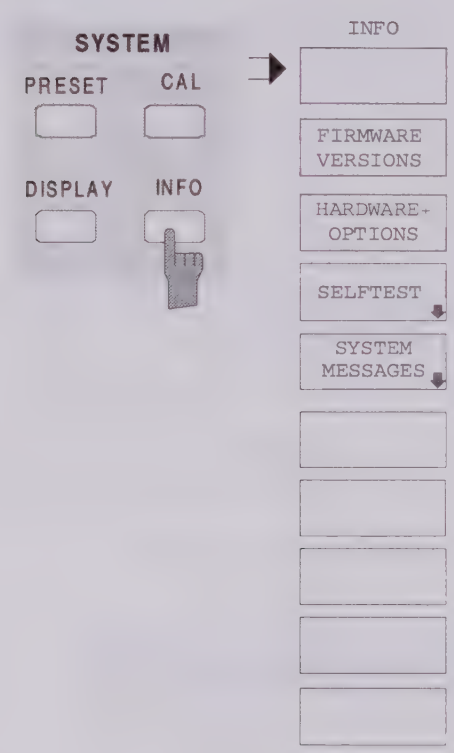
```
CALIBRATION: PASSED
Last cal total: 05.Jun 1997 16:24:54

Calibration of IF Filters    PASSED
IF GAIN Adjust               PASSED
Bandwidth:
Filter   Cal Val [Hz] DAC Val State
  1kHz    2.806e+01    1679   PASSED
  2kHz    1.603e+01    2887   PASSED
  3kHz   -6.012e+00    3238   PASSED
  5kHz   -1.002e+01    3514   PASSED
 10kHz    1.804e+02    3703   PASSED
 20kHz    3.607e+02    3801   PASSED
 30kHz    8.417e+02    3831   PASSED
 50kHz    1.403e+03    3743   PASSED
100kHz    1.804e+03    3698   PASSED
200kHz    3.607e+03    3606   PASSED
300kHz    8.417e+03    3516   PASSED
500kHz    1.403e+04    3329   PASSED
  1MHz    2.806e+04    2881   PASSED
```

The *PAGE UP* and *PAGE DOWN* soft keys can be used to page through the table of calibration results.

2.4.4 Instrument Status and Measurement Parameters – *INFO Key*

SYSTEM INFO menu:



The *INFO* key is used to request general information concerning the instrument. These include:

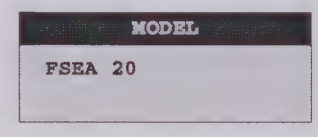
- firmware version
- installed hardware options
- modification level of the individual modules
- self-test results with the option of calling self-test functions
- list of generated system messages

2.4.4.1 Firmware Versions

SYSTEM INFO menu:

The *FIRMWARE VERSIONS* soft key opens two tables, which provide the following informations:

- Table MODEL displays the exact instrument model.



- In the FIRMWARE VERSION table, the version of each software component installed in the instrument is listed. The versions of programmable logic devices are also included if the firmware version of the device can be determined.

2.4.4.2 Hardware Configuration and Options

SYSTEM INFO menu:

The *HARDWARE+OPTIONS* soft key opens two tables in which the modules (INSTALLED COMPONENTS) installed in the instrument are listed.

- Table *MODEL* lists the instrument name and model:

MODEL
FSEA 20

- Table *INSTALLED COMPONENTS* consists of four columns:
  COMPONENT name of module
  MODEL INDEX model number of the module
  MODIF INDEX main modification index of the module
  HW CODE secondary modification index of the module

  These lists contain only the modules which are actually present in the instrument, i.e., the modules which were identified by the module recognition software.

INSTALLED COMPONENTS			
COMPONENT	MODEL INDEX	MODIF INDEX	HW CODE
Main Processor	4	n/a	0
Graphic Board	4	n/a	0
I/O Board	4	n/a	0
FRAC SYN	4	0	4
RF Module	4	0	4
2nd IF Converter	3	2	2
Detector	4	0	2
IF Filter	3	2	3
Digital IF	2	0	2

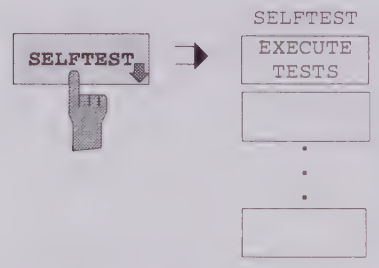
The *FIRMWARE OPTIONS* softkey opens a table listing the firmware options installed.

FIRMWARE OPTIONS		
DESIGNATION	TYPE	CODE
FFT	B5	1938496289

Note: *New firmware options can be enabled in the SETUP menu.*

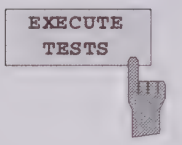
2.4.4.3 Self Test

SYSTEM INFO-SELFTEST submenu:



The *SELFTEST* soft key opens a submenu with which the self test can be started.

The instrument has extensive self test functions which comprehensively test instrument functionality. In case of a fault, the instrument can locate a defective module on its own. The self test sequence is described in more detail in chapter 4 (Maintenance and Troubleshooting).



The *EXECUTE TESTS* soft key starts the test of the complete instrument. During the self test a window is displayed:

The functions are tested in the following order:

1. Modules main CPU, digital motherboard, graphics and the interfaces
2. Reference frequency conditioning, the synthesizer modules and all LO signals
3. All RF, IF and signal-weighting modules

If no failure occurs during the execution of the self test, the following message is displayed when the complete self test is finished:

If a failure occurs during the execution of the self test, the self test is immediately aborted and a message indicating the defective module and the defective function is displayed:

Further testing should be performed by an R&S service department.

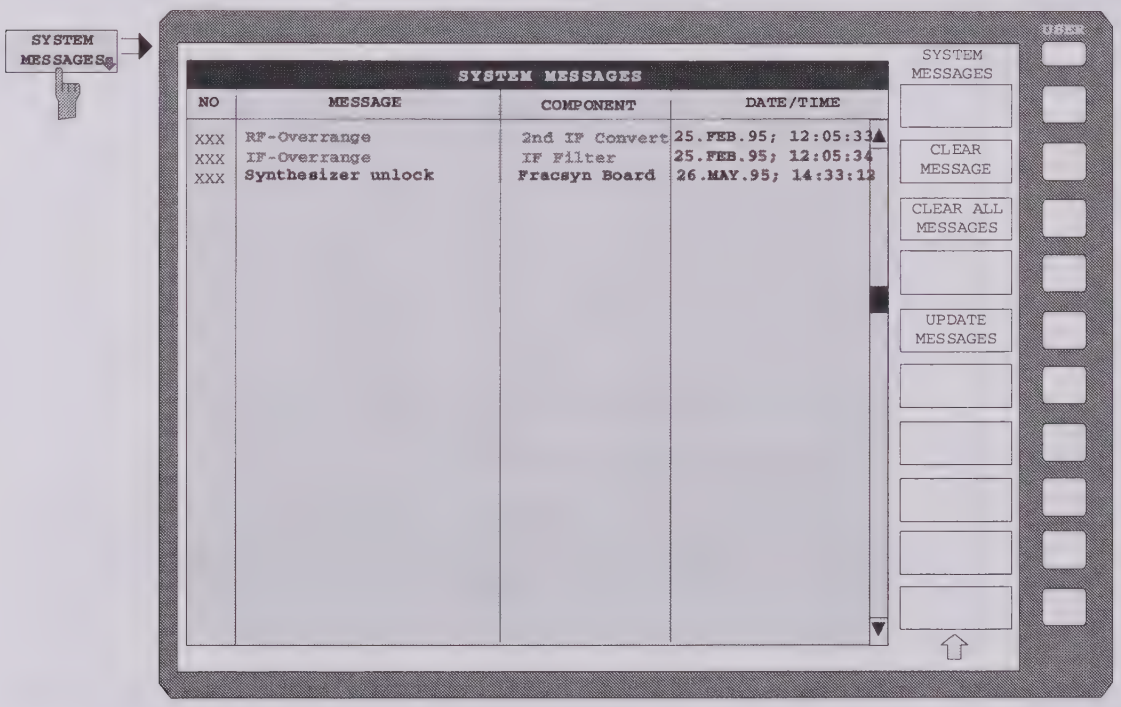
2.4.4.4 System Messages

The *SYSTEM MESSAGES* soft key opens a submenu including a table in which the generated system messages are displayed. The most recent messages are at the top of the list.
The following information is presented:

NO	Device specific three digit error code (shown as XXX in the figure)
MESSAGE	Brief description of the reason for the message
COMPONENT	Hardware messages name of the affected module Software messages if needed, the name of the affected software components
DATE/TIME	Date and time of occurrence of the message

The system messages are displayed in various colors.
Red error message The message has occurred since the last call to the *SYSTEM MESSAGES* menu,
Black error message The message was already present at the last call.

SYSTEM INFO-SYSTEM MESSAGES submenu:



The *CLEAR MESSAGE* soft key deletes the message just selected.
All subsequent messages are shifted automatically one line upwards so that no empty lines exist. When the last message has been deleted, the selection bar also disappears.

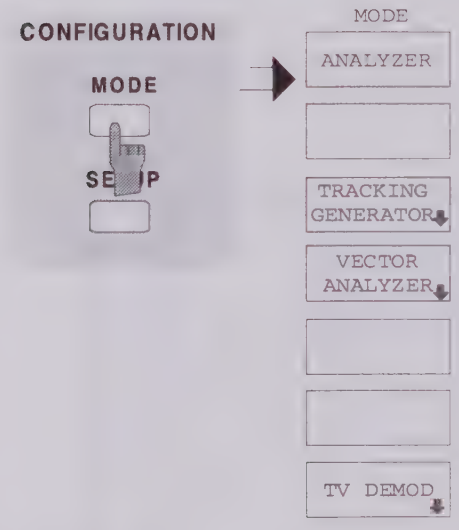
The *CLEAR ALL MESSAGES* soft key deletes all messages.

The *UPDATE MESSAGES* soft key causes all newly arrived messages to be entered at the top of the table.
At this time, all messages previously indicated as "new" are displayed as "old" messages

2.4.5 Mode Selection – *MODE Key*

The FSE can be operated in one of several modes, each of which is different with respect to functionality and control. The differences in control, however, consist not only in the enabling/disabling of additional soft keys within existing soft key menus, but rather in the fact that existing menus are completely replaced by new menus and menu trees which are tailored to the functional requirements. In the simultaneous application of two measurement diagrams, two modes are also simultaneously enabled. Each mode can be assigned to a measurement window.

CONFIGURATION MODE menu



The *MODE* key opens the menu for selection of the mode.

Herein, the modes can be selected according to the available FSE options.

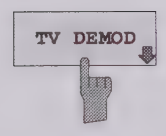
- Analyzer
- Tracking Generator
- Vector Signal Analysis and
- TV Demodulation

The *ANALYZER* soft key selects the *ANALYZER* mode.

This mode is the default setting of the FSE.

The functions provided correspond to those of a conventional spectrum analyzer. The analyzer measures the frequency spectrum of the test signal over the selected frequency range with the selected resolution and sweep time, or, for a fixed frequency, displays the waveform of the video signal.

The *TRACKING GENERATOR* soft key selects the operating mode Scalar Network Analysis.
The softkey is only available if FSE is equipped with one of the following options: FSE-B8/B9/B10 and B11. For a detailed description of operation see manual of options.



The *TV DEMOD* softkey selects the operating mode TV Demodulation.
The softkey is only available if FSE is equipped with Option FSE-B3. For a detailed description of operation see manual of options.

Softkey *VECTOR ANALYZER* selects the vector analysis mode.

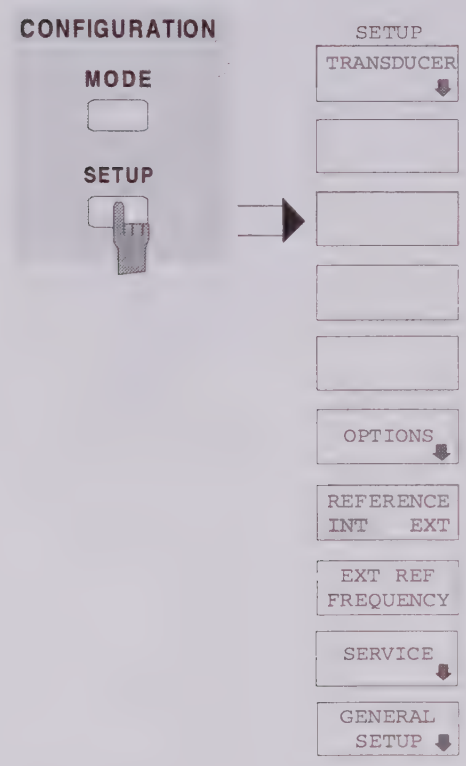
The softkey is only available if FSE is equipped with Option FSE-B7. For a detailed description of operation see manual of option.

In the vector analyzer mode the FSE is automatically set to a fixed frequency (centre frequency) since vector analysis can only be carried out on one frequency.
The IF signal is digitized by the selected resolution bandwidth after filtering and mixed into the baseband by a digital mixer. Further processing is via digital signal processors which display the time characteristic of the amplitude or phase. As an option, the baseband can also be demodulated and the demodulated signal can be displayed. Principally any type of modulation (digital and analog) can be processed.

The functions of the analyzer mode are supplemented by the vector analysis functions which are described in detail in a separate manual to the option.

2.4.6 Preliminary Setup and Interface Configuration – *SETUP Key*

CONFIGURATION SETUP menu:



The *SETUP* key opens the menu for configuration of the FSE.

The *TRANSDUCER* softkey opens a submenu to consider the characteristics of transducers in the test result.

The *OPTIONS* softkey allows the enabling of firmware options (Application Firmware Modules).

The *REFERENCE INT/EXT* and *EXTERNAL REF FREQUENCY* soft key determine the reference to be used.

The *SERVICE* soft key provides special setup functions which, although not necessary in normal use, are useful in instrument service.

The *GENERAL SETUP* softkey opens a submenu for all the general settings such as date and time as well as the configuration of the device interfaces.

2.4.6.1 Using Transducers

A transducer is often connected ahead of FSE both during the measurement of useful signals and EMI and converts the useful or interference variable such as field strength, current or RFI voltage into a voltage across 50 Ohm. Transducers with a frequency-independent transducer factor can be coded in 10-dB steps together with the unit at connector *PROBE CODE*. They are supplied at the same time by this connector. Transducers such as antennas, probes or current probes mostly have a frequency-dependent transducer factor which can be stored in FSE and automatically has the correct unit during level measurement.

If a transducer is switched on it is considered as part of the unit during the measurement, ie the measured values are displayed in the correct unit and magnitude. When working with two measurement windows, the transducer is always assigned to two windows.

FSE distinguishes between **transducer factor** and **transducer set**. A transducer factor takes the frequency response of a single transfer element, eg an antenna into consideration. A transducer set can summarize different transducer factors in several subranges (several transducer factors at the same time), eg an antenna, a cable and a diplexer.

A transducer factor consists of max. 50 reference values defined with frequency, transducer factor and the unit.

Several factors can be compiled in a transducer set provided that all factors have the same unit or unit "dB". The frequency range covered by a set can be subdivided into max. 10 subranges (each with up to 4 transducer factors) which follow each other without a gap, ie the stop frequency of a subrange is the start frequency of the next subrange.

The transducer factors used in a subrange have to fully cover the subrange.

The definition of a transducer set is recommended if different transducers are used in the frequency range to be measured or if a cable attenuation or an amplifier has to be taken into consideration.

If a transducer set is defined during a frequency sweep, the latter can be stopped at the interface between two transducer ranges and the user is asked to exchange the transducer.
The following message informs the user that the limit has been reached:

TDS Range # reached, CONTINUE / BREAK

He can continue the sweep by confirming the message (*CONTINUE*) or he can switch off the transducer (*BREAK*).

With the automatic switchover of the transducer used, the frequency sweep is not interrupted.

Note: *Transducers cannot be used in vector analyzer mode.*

2.4.6.1.1 Activating Transducer Factors and Transducer Sets

The *TRANSDUCER* softkey opens a submenu in which already defined transducer factors or sets can be activated or deactivated, new transducer factors or sets can be generated or existing transducer factors or sets can be edited. Tables with the defined transducer factors and sets are displayed. The table (factor or set) in which a transducer is active is set.

By switching on the transducers all the level settings and outputs are automatically made in the unit of the transducer. A change of the unit in menu *LEVEL REF* is no longer possible as FSE together with the transducer used is regarded as a measuring instrument. Only if the transducer has the unit dB, can the original unit at FSE be maintained and changed.

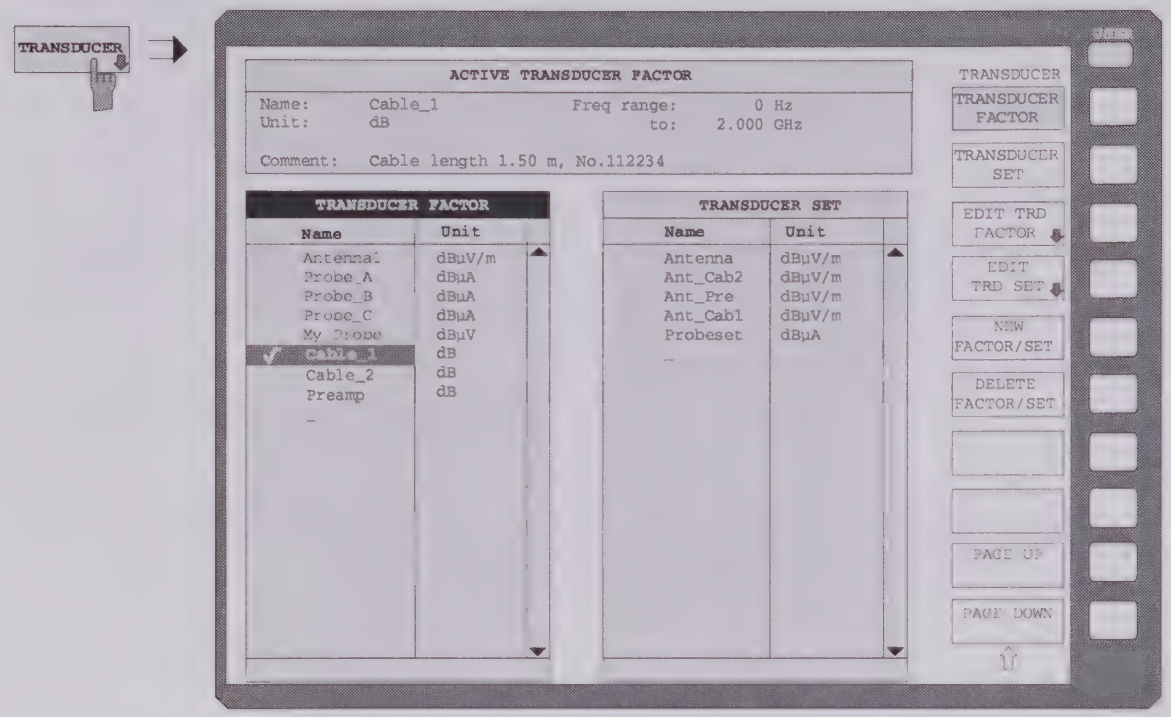
Note: *If one of the units dBµV, dBµV/m, dBµA, or dBµA/m is selected, the LEVEL REF key (see UNIT-submenu) can be used to switch to the corresponding units referred to the bandwidth, i.e. dBµV/MHz, dBµV/mMHz, dBµA/MHz, dBµA/mMH.*

If a transducer factor is active, TDF is displayed in the column of the enhancement labels and TDS if the transducer set is active.
After switching off all the transducers, FSE continues to use the unit which was selected before a transducer was switched on.

In the analyzer mode, an active transducer for a sweep is uniquely calculated for each point displayed after its setting and added to the result of the level measurement during the sweep. If the sweep range is changed, the correction values are recalculated. If several measured values are combined, only a single value is taken into consideration.

If an active transducer factor/set is not defined over the whole sweep or scan range during the measurement, the missing values are replaced by zero.

CONFIGURATION SETUP Menu

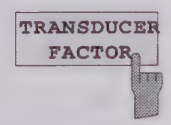


The upper table *ACTIVE TRANSDUCER FACTOR / SET* indicates the active transducer factor or the set with the associated name, frequency range and unit. If no factor or set is active, *none* is displayed in the table. Additional information can be entered in a comment line. If a transducer factor is active, the selected interpolation is displayed in addition, if a set is active, the break setting is displayed.

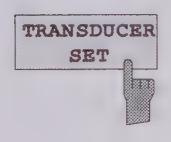
The left table *TRANSDUCER FACTOR* comprises all the defined factors with name and unit. If the number of defined transducer factors exceeds the number of possible lines in the table, the table will be scrolled.

The right table *TRANSDUCER SET* comprises all the defined transducer sets with the corresponding information.

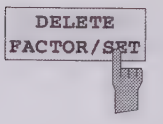
Only one set or transducer can be activated. An already active transducer factor or set is switched off automatically if another one is switched on. An activated transducer factor or set is marked with a check sign.



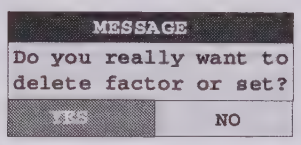
The *TRANSDUCER FACTOR* softkey sets the selection bar to the position of the active transducer factor.
If no transducer factor is switched on, the bar is positioned to the first line of the table.

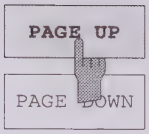


The *TRANSDUCER SET* softkey sets the selection bar to the position of the active transducer set.
If no transducer set is switched on, the bar is set to the first line of the table.



The *DELETE FACTOR/SET* softkey deletes the marked factor or set. To avoid deletion by mistake, deletion has to be confirmed.





The *PAGE UP* and *PAGE DOWN* softkeys are used to scroll in large tables which cannot fully be displayed on the screen.

2.4.6.1.2 New Entry and Editing of Transducer Factors

A transducer factor is characterized by

- reference values with frequency and transducer factor (*Values*)
- the unit of the transducer factor (*Unit*) and
- the name (*Name*) to distinguish between the different factors.

During the entry, FSE checks the transducer factor according to specific rules that have to be met to ensure trouble-free operation.

- The frequencies for the reference values always have to be entered in ascending order. Otherwise, the entry is not accepted and the following message is displayed:

  Frequency Sequence!

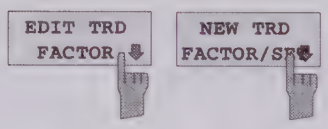
- The entered frequencies do not necessarily have to be set at FSE, as only the values for the frequency display range are considered for a set sweep or scan. The minimum frequency for a reference value is 0 Hz, the maximum frequency 200 GHz.

- The minimum or maximum value for a transducer factor is -200 dB or 200 dB. The unit "dB" means that the transducer factor is always logarithmic and has nothing to do with the physical transducer factor, which, for example, establishes the relationship between field strength and voltage into 50 Ohm. If the minimum or maximum value is exceeded, FSE signals:

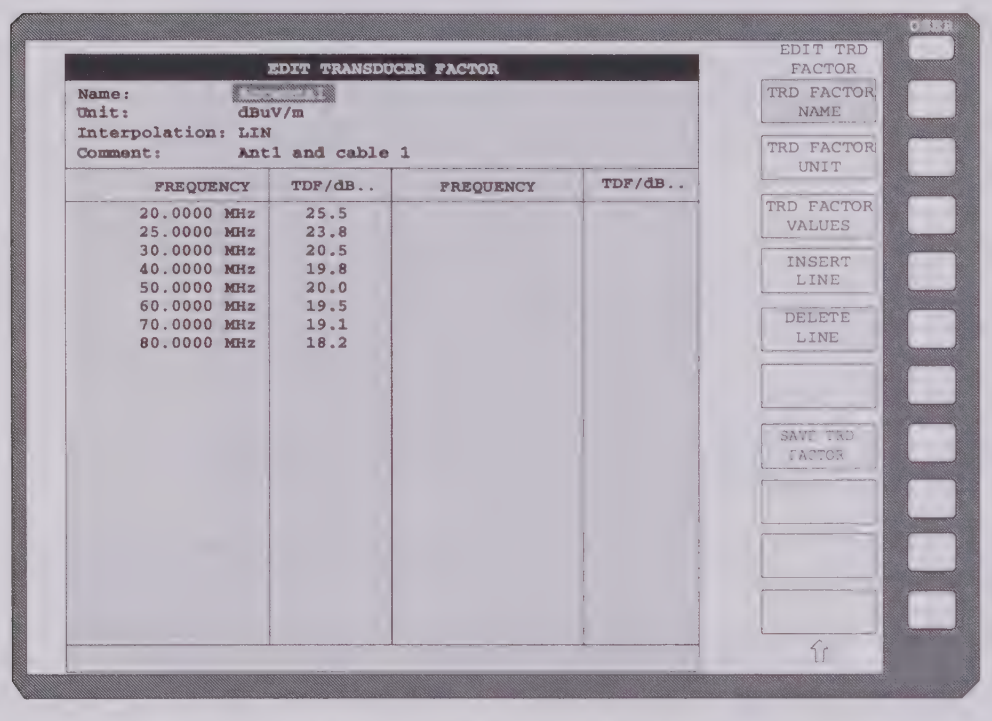
  Min Level -200 dB or
  Max Level 200 dB.

- Amplifiers have a negative transducer factor, attenuation values have to be entered as a positive transducer factor.

Note: *A unit activated by switching on the transducer has priority over a coded unit of the connected probe.*
With the exception of dB/MHz, the softkeys for the unit in the menu under key LEVEL REF are inoperative with the transducer switched on.*



The *EDIT TRD FACTOR* and *NEW FACTOR/SET* softkeys both open the submenu for editing and entering new transducer factors. A precondition for the *NEW FACTOR/SET* softkey is that the selection bar is located in the table when the table *TRANSDUCER FACTOR* is called up.



The table with the data of the marked factor (the *EDIT TRD FACTOR* softkey) or an empty table is displayed in which the following entries are preset (the *NEW FACTOR/SET* softkey):

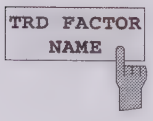
Unit: dB

Interpolation: LIN for linear frequency scaling

The characteristics of the factor can be entered in the header field of the table, the frequency and the transducer factor in the columns of the table.

Name	Entry of the name
Unit	Selection of unit
Interpolation	Indication of interpolation
Comment	Entry of a comment
FREQUENCY	Entry of the frequency of the reference points
TDF/dB	Entry of the transducer factor.

An overwritten transducer factor remains stored in the background as long as the edited factor is stored with the *SAVE TRD FACTOR* softkey or until the table is closed. A factor overwritten by mistake can be restored by leaving the entry.



The *TRD FACTOR NAME* softkey activates the entry of the transducer factor characteristics in the header field of the table.

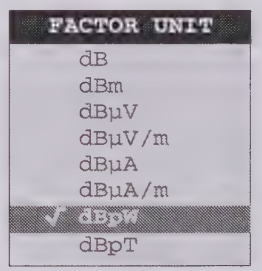
***Name* - Entry of name**

A maximum of 8 characters is permissible for the name. The characters have to comply with the convention of DOS file names. The unit automatically stores all transducer factors with the extension .TDS.

If an existing name is changed, the factor stored under the previous name is retained and will not be overwritten automatically with the new name. The previous factor can be deleted at a later time, using *DELETE FACTOR/SET*. Thus, factors can be copied.

***Unit* - Selection of unit**

The unit of the transducer factor is selected from a selection box activated by the *TRD FACTOR UNIT* softkey.



The default setting is dB.

Caution:
The unit for a transducer factor or transducer set cannot be changed at a later time

***Interpolation* - Indication of interpolation**

The following diagrams indicate the effect of the interpolation on the calculated characteristic:

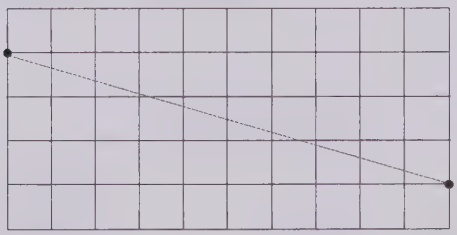


Fig. 2.4-2 Linear frequency axis and linear interpolation

***Comment* - Entry of a comment**

The comment can be freely selected. It can have a maximum number of 50 characters.

The *TRD FACTOR VALUES* softkey activates the entry for the reference values of the transducer factor.

The selection bar marks the first reference value. The desired reference values have to be entered in ascending frequency sequence.
After entering the frequency the selection bar automatically jumps to the corresponding level value.

After entering the first reference value the table can be edited. The two *INSERT LINE* and *DELETE LINE* softkeys are displayed. Individual values are changed at a later time by marking the field and by entering the new value.

The *INSERT LINE* softkey inserts a free line above the marked reference value. When entering a new reference value into this line watch out for the ascending frequency sequence.

The *DELETE LINE* softkey deletes the marked reference value (the whole line). The following reference values move up.

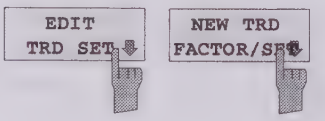
The *SAVE TRD FACTOR* softkey saves the changed table in a file on the internal hard disk.

If a transducer factor with the same name already exists, a corresponding query is performed beforehand.

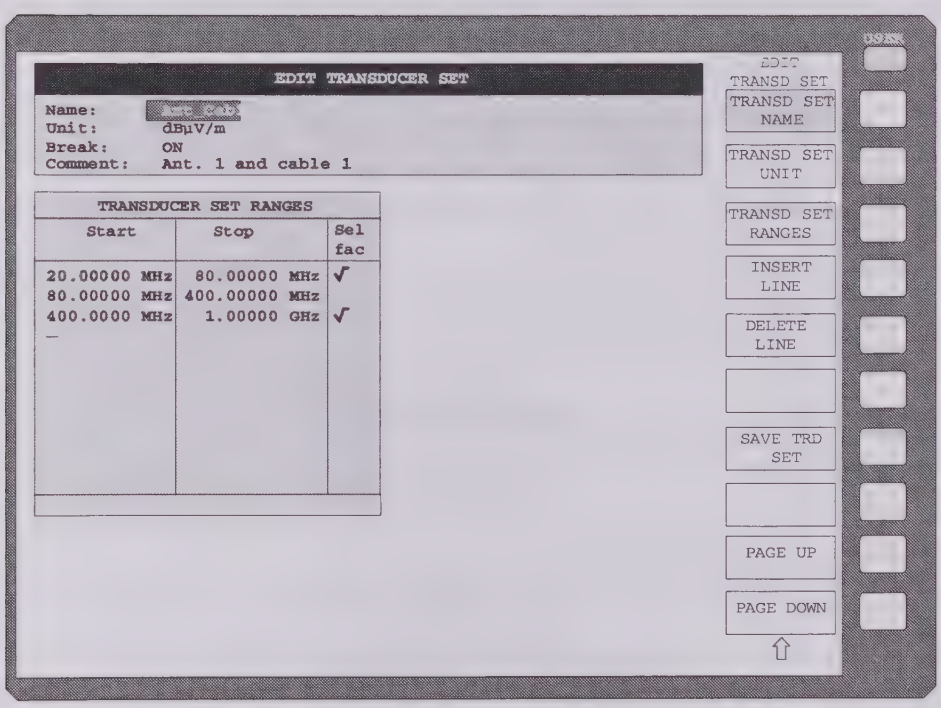
If the factor to be newly saved is currently switched on, the new values will immediately be valid. If a transducer set is switched on comprising the factor, the values will only be used when the set is switched on next time.

2.4.6.1.3 New Entry and Editing of Transducer Sets

A transducer set is characterized by:
- maximum 10 ranges (*Ranges*) in which different transducer factors can be active
- the combination of several transducer factors per range (*Factor*)
- a transducer-set name *(Name)*



The *EDIT TRD SET* and *NEW FACTOR/SET* softkeys both open the submenu for editing and entering new transducer factors. A precondition for the *NEW FACTOR/SET* softkey is that the selection bar is located in the table *TRANSDUCER SET*.



The table with the data of the marked set (the *EDIT TRD SET* softkey) or an empty table in which the following entries are preset (the *NEW FACTOR/SET* softkey) is displayed:

Unit: dB
Break: NO

The characteristics of the set can be entered in the header field of the table, the subranges in the columns of the set.

Name	Entry of the name
Unit	Selection of unit
Break	Activating the query when changing the changing the subrange
Comment	Entry of a comment
Start	Entry of the start frequency of the subrange
Stop	Entry of the stop frequency of the subrange
Sel Fac	Selection of the transducer factors for the subrange

An overwritten transducer set remains stored in the background as long as the edited factor is stored with the *SAVE TRD SET* softkey or until the table is closed. A set overwritten by mistake can be restored by leaving the entry.

The *TRD SET NAME* softkey activates the entry of the transducer set characteristics in the header field of the table.

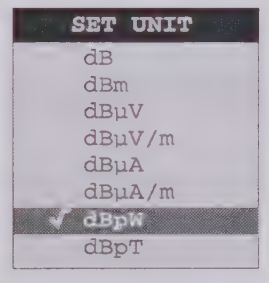
***Name* - Entry of name**

A maximum of 8 characters is permissible for the name. The characters have to comply with the convention of DOS file names. The unit automatically stores all transducer sets with the extension .TDS.

If an existing name is changed, the set stored under the previous name is retained and will not be overwritten automatically with the new name. The previous set can be deleted at a later time using *DELETE FACTOR/SET*. Thus, sets can be copied.

***Unit* - Selection of unit**

The unit of the transducer set is selected from a selection box activated by the *TRANSD SET UNIT* softkey.
The unit should be selected prior to the entry as it determines the settable transducer factors. The preset unit for new sets is "dB". The unit can no longer be changed when editing a set as the set of selected transducer factors will otherwise become inconsistent.



***Break* - Activation of query when changing a subrange**

The sweep can be stopped if the user changes the subrange and selects a new subrange of the transducer. A message informs the user that the limit has been attained. He can continue the sweep or switch off the transducer.
The interruption is activated by setting Break to ON. Selection is by the ENTER key which toggles between ON and OFF (toggle function).

***Comment* - Entry of a comment**

The comment can be freely selected. It can have a maximum number of 50 characters.

Softkey *TRANSD SET RANGES* activates the entry of subranges and the associated transducer factors. The selection bar marks the frequency values last active.

***Start* - Entry of start frequency of subrange**
***Stop* - Entry of stop frequency of subrange**

The individual subranges have to be linked without a gap. That is why the start frequency is already defined from the second subrange (= stop frequency of previous range).

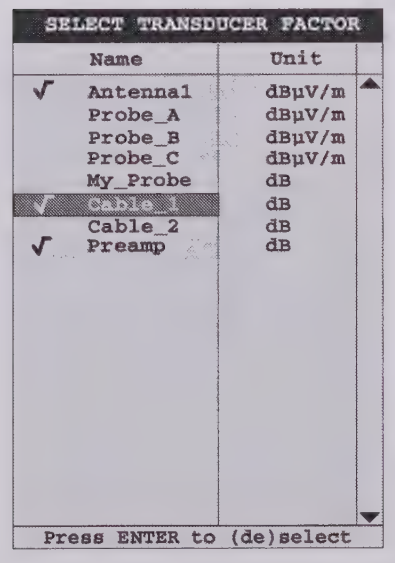
After entering the first frequency value the table can be edited. The two *INSERT LINE* and *DELETE LINE* softkeys are displayed. Some values are changed at a later time by marking the field and by entering the new value. It should be noted that both the stop frequency of a particular subrange and the start frequency of the subsequent subrange are changed to the same extent.

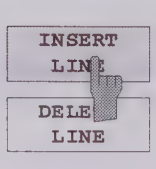
***Sel fac*- Selection of factors for the subrange**

A check sign in column *Sel Fac* (select factor) indicates whether one or several transducer factors were selected for the subrange.

The permissible transducer factors for the marked subrange can be selected in a selection box. Only factors matching with the unit of the set and fully covering the selected subrange are permissible.
After each change of range limits, FSE thus checks the factor list and, if required, rebuilds it.
After reducing the start frequency or increasing the stop frequency of a range it may happen that the factors defined for this range no longer fully cover the range. These factors are deleted for this range when the transducer factor table is opened next time.

A maximum of 4 transducer factors can be switched on at the same time in each subrange. If none of them is switched on, 0 dB is assumed as a factor for the whole subrange.



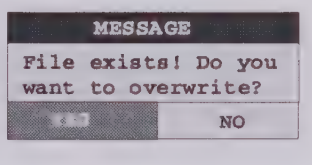


The *INSERT LINE* softkey inserts a free line above the marked subrange.

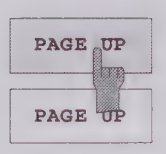
The *DELETE LINE* softkey deletes the marked subrange (whole line). The following subranges move up.

In both cases FSE checks that the ranges follow each other without a gap.

The *SAVE TRD SET* softkey saves the changed table in a file on the internal hard disk. If a transducer name with the same name already exists, a corresponding query is performed beforehand:



After pressing ENTER, the data set is overwritten on the hard disk.
If the saved set is switched on, the new values will be used immediately.



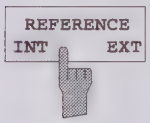
The *PAGE UP* and *PAGE DOWN* soft keys set the table to the next or previous page.

The soft keys are locked during selection of factors in the right table.

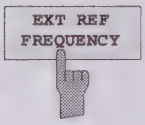
2.4.6.2 External Reference Oscillator

In general, the FSE can generate all internal oscillators from either the internal or an external reference oscillator. A 10 MHz quartz-controlled oscillator is used as the internal reference. A reference oscillator output is also available at the rear panel via the EXT REF IN/OUT connector.
This output can be used, e.g., to synchronize other instruments to the FSE. This connector can also be converted to an input connector for application of an external frequency standard. The FSE requires that the frequency of the external standard be entered so that the internal oscillators can be synchronized to it.

CONFIGURATION SETUP Menu:



The *REFERENCE INT EXT* soft key switches between the internal and external references.

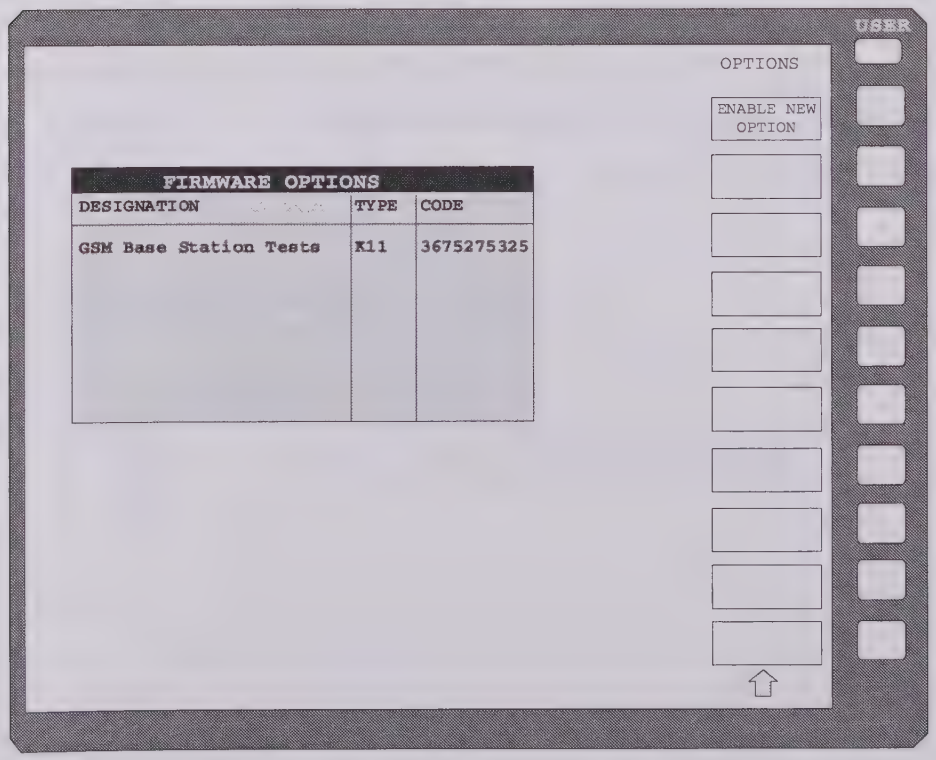


The *EXT REF FREQUENCY* soft key activates the entry of the frequency of the external source.
Range of input values is 1 MHz to 16 MHz in 1 MHz steps.

2.4.6.3 Enabling Firmware Options

CONFIGURATION SETUP menu:

The *OPTIONS* soft key opens a submenu for entering keywords for new firmware options (Application Firmware Modules). Options which are already available are indicated in a table that is opened when the menu is called.



The *ENABLE OPTION* soft key activates the entry of a keyword for a firmware option.

One or several keywords may be specified in the entry field. When a valid keyword is entered, the message OPTION KEY OK appears in the info line and the option is written into the FIRMWARE OPTIONS table.

The FIRMWARE OPTIONS table can also be displayed using the *FIRMWARE OPTIONS* soft key in the *INFO* menu.

If a keyword is invalid the message OPTION KEY INVALID is displayed in the info line.

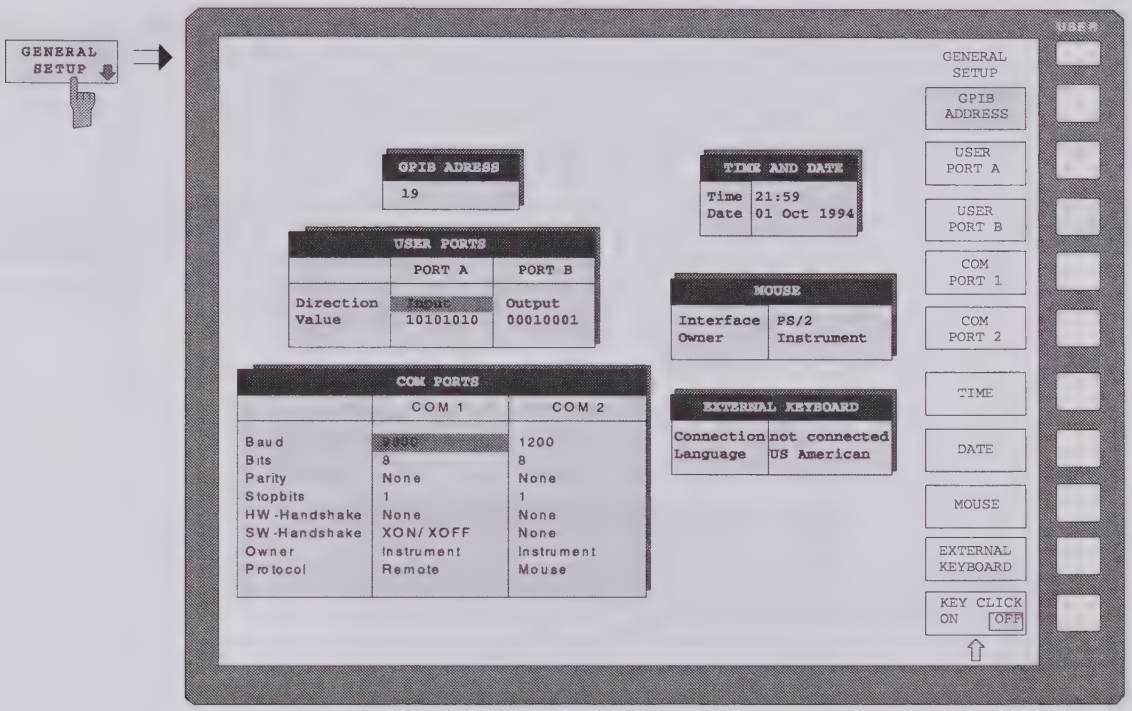
2.4.6.4 Programming the Interface Configuration and Time

The *GENERAL SETUP* soft key branches to a sub-menu in which the basic setup of general instrument parameters may be performed. In addition to the configuration of the digital interfaces (*IECBUS, COM, LPT* and *MOUSE*), the date and time, the selection of keyboard language as well as the configuration of the *USER PORTS* may be entered.

The current settings are displayed in tabular form on the display screen where they may then be edited.

Note: *Interface LPT cannot be configured. If the option FSE-B15, computer function, is installed, LPT1 can be used for printing in both the measurement instrument mode and the DOS mode. However, it can only be used for one mode at a time.*

CONFIGURATION SETUP menu:



2.4.6.4.1 IEC Bus Address Selection

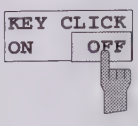
CONFIGURATION SETUP-GENERAL SETUP submenu:

The *GPIB ADDRESS* soft key activates the entry of the IEC Bus address.

Permitted addresses are 0 through 30. The default setting is address 20.

2.4.6.4.2 Switching the Beeper ON/OFF

CONFIGURATION SETUP-GENERAL SETUP submenu:



The *KEY CLICK ON/OFF* soft key switches the beeper on or off. The beeper acknowledges each key stroke with a beep.

2.4.6.4.3 User Port Configuration

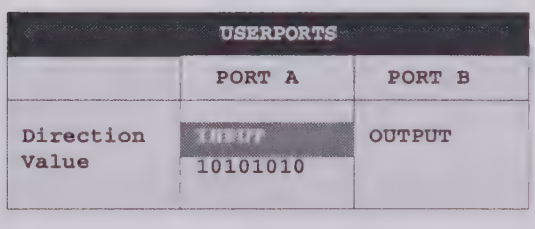
The instrument provides two parallel interfaces, each of which is 8 bits wide. Over these ports, arbitrary bit patterns can be output or input. The interfaces are designated *USER PORT A* and *USER PORT B*.

CONFIGURATION SETUP-GENERAL SETUP submenu:

The USER PORT A and *USER PORT B* soft keys activate the columns PORT A and PORT B, respectively, in the USERPORTS table for entry of the parameters for both of the parallel interfaces in the instrument. Because the two interfaces are configured in the same manner, how to configure an interface is described in the following using *USER PORT A*.

The following parameters need to be configured in the table:

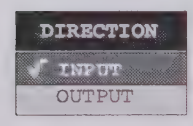
Direction	Direction of data transmission
Value	Indication/entry of current value



***Direction* – Direction of data transmission**

The *DIRECTION* parameter determines in which direction the interface transmits data.

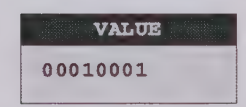
INPUT	read operation
OUTPUT	write operation



***Value* – Indication/Entry of current value**

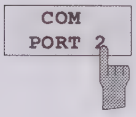
The *VALUE* parameter shows the current value of the data at the port for data input as well as for data output. The displayed data is in binary format with the least significant bit (LSB) on the right.

If the port is configured as an *OUTPUT* then, the displayed value can be edited. Data entry must also be in binary format (i.e., only the digits 0 and 1 are accepted).



2.4.6.4.4 Serial Interface Configuration

CONFIGURATION SETUP-GENERAL SETUP submenu.



The *COM PORT 1* and *COM PORT 2* soft keys activate the columns COM1 and COM2, respectively, for entry of the serial interface parameters. Since the two interfaces are configured in the same manner, how to configure an interface is described in the following using *COM PORT 1*.

The following parameters need to be configured in the table:

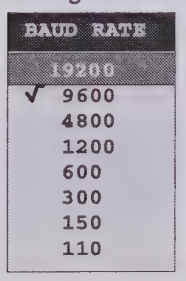
Baud rate	data transmission rate
Bits	number of data bits
Parity	bit parity check
Stop bits	number of stop bits
HW-Handshake	hardware handshake protocol
SW-Handshake	software handshake protocol
Owner	assignment to the measuring instrument or computer
Protocol	transmission protocol

COM PORTS		
	COM 1	COM 2
Baud	9600	1200
Bits	8	8
Parity	None	None
Stopbits	1	1
HW-Handshake	None	None
SW-Handshake	XON/XOFF	None
Owner	Instrument	Instrument
Protocol	Remote	Remote

Note: *A serial interface (COM1 or COM2) cannot be used for another purpose if a mouse is connected to it.*

Baud – Data transmission rate

Allowed are the indicated values between 110 and 19200 baud. The default setting is 9600 baud.



Bits – Number of data bits per word

For the transmission of text without German umlauts (Ä, ä, Ü, ü, Ö, ö) and special characters, 7 bits are adequate. For binary data as well as text with special characters or umlauts, 8 bits must be selected (default setting).

***Parity* – Bit parity check**

NONE no parity check (default setting)
EVEN even parity check
ODD odd parity check

***Stop bits* – Number of stop bits**

Available are 1 and 2. The default setting is 1 stop bit.

***HW-Handshake* – Hardware handshake protocol**

The integrity of data transmission can be improved through the use of a hardware handshake protocol which effectively prevents uncontrolled transmission of data and the resulting possible loss of data bytes. In the hardware handshaking procedure, additional interface lines are used to transmit acknowledge signals with which the data transmission can be controlled and, if necessary, stopped until the receiver is ready to receive data again.

A prerequisite for handshaking is, however, that the interface lines (DTR and RTS) are provided between sender and receiver. For a simple, 3-wire connection, this is not the case and hardware handshake cannot be realized here.

Default setting is *NONE*.

***SW-Handshake* – Software handshake protocol**

Besides the hardware handshake procedure using interface lines, it is also possible to achieve the same effect by using a software handshake protocol. Here, control bytes are transmitted in addition to the normal data bytes. These control bytes can be used, as necessary, to stop data transmission until the receiver is ready to receive data again.

In contrast to hardware handshaking, software handshaking can be realized even for a simple, 3-wire connection.

One limitation is, however, present in software handshaking. Software handshaking cannot be used for the transmission of binary data since, the control characters XON and XOFF require bit combinations that are also used for binary data transmission.

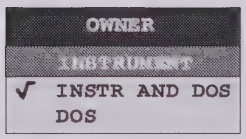
Default setting is *NONE*.

Owner – Assignment of the interface

When the processor option FSE-B15 is installed, the serial interface can be assigned alternatively to the instrument measurement section, the DOS section or to both sections of the FSE.

If the interface is assigned to only one section of the instrument, it is not available to the other section.

INSTRUMENT	The interface is assigned to the instrument measurement section. Outputs to the interface from DOS are not possible and, so to say, land nowhere.
DOS	The interface is assigned to the DOS section. It cannot be used by the instrument measurement section. This means that hardcopy or remote control of the instrument via the interface is not possible. An attempt to start a print job via the interface results in an error message. The *PROTOCOL* parameter has no meaning in this mode.
INTR AND DOS	The interface is allocated to both instrument sections. It may be used alternately by each section. This means that a hardcopy job from the measurement section and a data transfer from DOS are not possible at the same time. This would lead to a mixing of the data streams. The set interface parameters, with the exception of *PROTOCOL*, are valid for both instrument sections. The *PROTOCOL* parameter is only of interest for the measurement section.

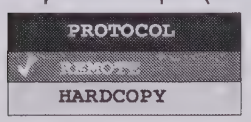


Note: *DOS programs cannot independently recognize changed interface parameter settings.*

Protocol – Transmission protocol

The parameter allows the selection of special transmission protocols for measurement functions. The interface can be configured for:

- remote control as single instrument
- printer output (hardcopy)



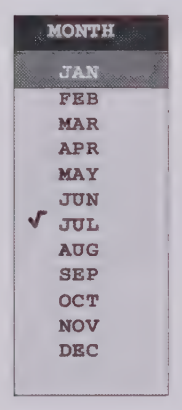
2.4.6.4.5 Setting Date and Time

CONFIGURATION SETUP-GENERAL SETUP submenu:

The *TIME* soft key activates the entry of time for the internal real time clock . In the corresponding dialog box, the time is partitioned into two input fields so that hours and minutes can be entered independently.

The *DATE* soft key activates the entry of the date of the internal real-time clock. In the corresponding dialog box, the date is partitioned into 3 input fields so that day, month and year can be input separately.

For the selection of the month, pressing a units key opens a list of abbreviations wherein the desired month can be selected.

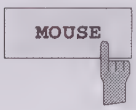


2.4.6.4.6 Mouse Configuration

How to connect a mouse is described in chapter 1, section "Connecting a Mouse", the operation of the instrument with a mouse is described in chapter 2, section "Mouse and External Keyboard Control".

Caution:
The keyboard may only be connected when the instrument is switched off (STANDBY). Otherwise, correct operation of the keyboard cannot be guaranteed.

CONFIGURATION SETUP-GENERAL SETUP submenu:

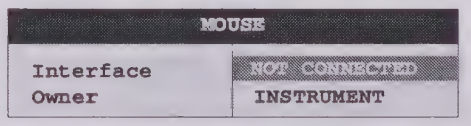


The *MOUSE* soft key activates the *MOUSE* table for configuration of the mouse.

The following parameters need to be configured in the table:

Interface Selection of interface

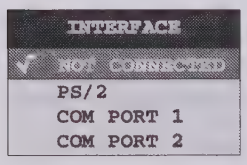
Owner Assignment of mouse



***Interface* – Selection of the interface**

If one of the serial interfaces is selected *(COM PORT 1* or *COM PORT 2)*, its interface parameters are automatically reconfigured so that mouse operation is possible.

NOT CONNECTED	No connection
PS/2	MOUSE connector on the rear panel
COM PORT 1	COM1 connector on the rear panel
COM PORT 2	COM2 connector on the rear panel

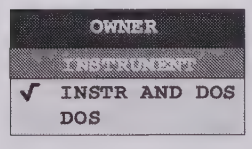


***Owner* – Assignment of the mouse**

If the processor option FSE-B15 is installed, the mouse can alternately be assigned to the instrument measurement section, the DOS section or to both sections simultaneously.

If the mouse is assigned to one section it is not available to the other section.

INSTRUMENT	The mouse is assigned to the instrument measurement section.
DOS	The mouse is assigned to the DOS section.
INTR AND DOS	The mouse is assigned to both sections.



2.4.6.4.7 External Keyboard Configuration

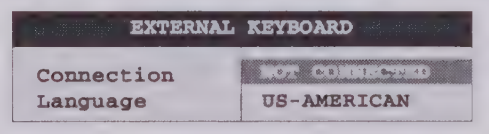
How to connect a keyboard is described in chapter 1, section "Connecting an External Keyboard", the operation of the instrument with an external keyboard is described in chapter 2, section "Mouse and External Keyboard Control".

Caution:
The keyboard may only be connected when the instrument is switched off (STANDBY). Otherwise, correct operation of the keyboard cannot be guaranteed.

CONFIGURATION SETUP-GENERAL SETUP submenu:

The *EXTERNAL KEYBOARD* soft key activates the *EXTERNAL KEYBOARD* table for configuration of the external keyboard.

Connection	Activation of the keyboard connection
Language	Language definition for measurement instrument operation



***Connection* – Activating the connection**

Activating the connection mainly determines whether or not the help line editor is available.

CONNECTED	A keyboard is connected. When an alphanumeric entry window is opened, the help line editor is no longer displayed automatically because it is no longer needed for editing.
NOT CONNECTED	The help line editor is opened automatically when alphanumeric parameters are edited.

***Language* – Language definition for measurement instrument operation**

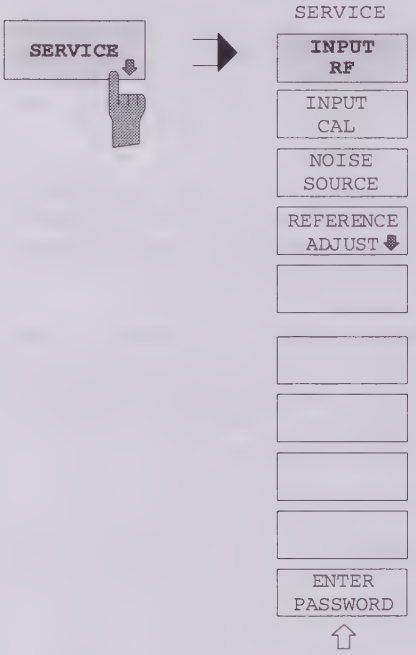
Available are US-American, German and French.

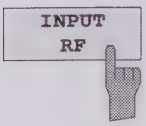
Note: *The language definition of the keyboard in DOS mode is independent of this setting and is determined by the appropriate MS-DOS command.*

2.4.6.5 Service Functions

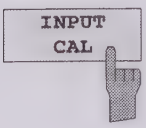
The service menu offers a variety of additional function which are used in maintenance and/or trouble shooting. The service functions are not necessary for normal measurements, however, incorrect use can impair the functionality and/or data integrity of the FSE. Therefore, many of the functions can only be used after entering a password.

CONFIGURATION SETUP menu:

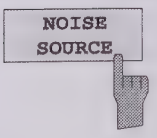




The *INPUT RF* and *INPUT CAL* soft keys are mutually exclusive selection switches. Only one switch can be active at any one time. They switch the input to the FSE between the *INPUT RF* connector (normal position) and the internal calibration source (120 MHz, -40 dBm).



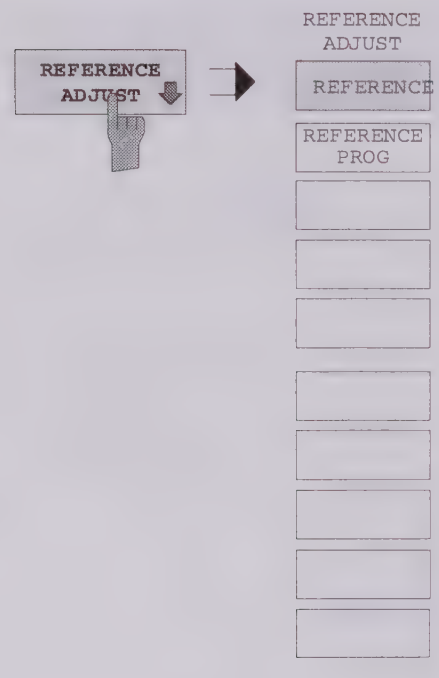
After *PRESET*, *RECALL* or FSE power on, the *INPUT RF* is always selected.



The *NOISE SOURCE* soft key switches on a noise source which is connected to the NOISE SOURCE connector on the instrument's rear panel.

The dc voltages on the connector are described in Annex A, section A.13.

CONFIGURATION SETUP SERVICE menu:



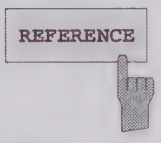
The *REFERENCE ADJUST* soft key opens a submenu used to adjust the frequency precision of the reference oscillator.
The value should be modified only after the frequency precision has been checked and found to be erroneous (setting range 0 ... 4095).

For more information about how to perform the adjustment of the frequency precision refer to chapter Kapitel 4 (Maintanance and Troubleshooting).
The modified reference value is preserved when the menu is closed.

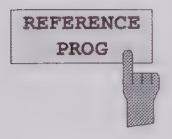
The current adjustment value can be permanently stored in an EEPROM in the instrument.

Caution: *As the specifications of the whole instrument depend directly on the setting of the reference oscillator (frequency precision), storing incorrect adjustment values should be avoided.*

Note: *If no adjustment value has been stored (REFERENCE PROG soft key) before the analyzer is switched off and on again, the factory-set value of the reference frequency or the value that has been programmed last will be used.*



The *REFERENCE* soft key adjusts the frequency precision of the reference oscillator.



The *REFERENCE PROG* soft key stores the current adjustment value in an EEPROM in the instrument.

The *ENTER PASSWORD* soft key allows the entry of a password.

The FSE contains a variety of service functions which, if incorrectly used, can impair the functionality of the analyzer. These functions are normally not accessible and are only usable after the entry of a password (*ENTER PASSWORD).*

2.5 Status Display-Remote/Manual Control – *STATUS Key Group*

The *SRQ* LED, the *REMOTE* LED and the *LOCAL.* key are contained in the *STATUS* key group.

- The *SRQ* LED indicates that a service request from the instrument has been asserted on the IEC Bus.
- The *REMOTE* LED indicates that the instrument is under remote control.
- The *LOCAL* key switches the instrument from remote to manual control, with the assumption that the remote controller has not previously set the LOCAL LOCKOUT function.

A change in the control mode consists of:

- **Enabling the Front Panel Keys**
  Under remote control, the soft-key menu is turned off and all keys, with the exception of *PRESET* and *LOCAL*, are disabled. Returning to manual mode enables all inactive keys. The soft key menu which is displayed is the main menu of the current mode.

- **Turning off the *REMOTE* LED**

- **Generating the message OPERATION COMPLETE**
  If, at the time of pressing the *LOCAL* key, the synchronisation mechanism via *OPC, *OPC? or *WAI is active, the currently running measurement procedure is aborted and synchronisation is achieved by setting the corresponding bits in the registers of the status reporting system.

- **Setting Bit 6 (User Request) of the Event Status Register**
  With a corresponding configuration of the status reporting system, this bit immediately causes the generation of a service request (*SRQ*) which is used to inform the software that the user wishes to return to front-panel control. This information can be used, e.g., to interrupt the control program so that the user can make necessary manual corrections to instrument settings. This bit is set each time the *LOCAL* key is pressed and is independent of whether or not the instrument is under remote or manual control.

- The *LOCAL* key aborts a running macro. The continuation of the macro is not possible.

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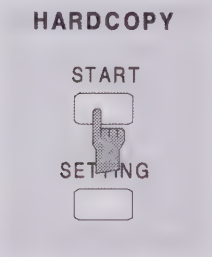
2.6 Measurement Documentation – *HARDCOPY* Key Group

2.6.1 Printing Data – *START* Key



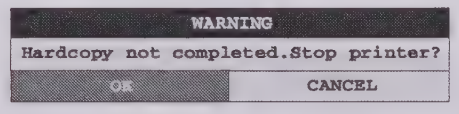
The *START* key initiates the printing of measurement/ instrument status data. The FSE can distinguish between two different output devices, each of which may be individually configured, e.g., a laser printer and a plotter. All documents are printed on the output device which is currently active.

Pressing the *HARDCOPY START* key initiates the print job. The printer parameters defined in the *HARDCOPY SETTINGS* menu are used for setting up the printer configuration. After pressing the *START* key, all of the display items to be printed are written to the printer buffer memory. Since the printer runs in the background, the instrument may be operated immediately after pressing the *START* key.

With *COPY SCREEN* selected in menu *HARDCOPY SETTINGS*, all the diagrams with traces and status displays are printed as they occur on the screen. Softkeys, open tables and data entry fields are not printed out. Function *COPY TRACE* allows to print out individual traces. With *COPY TABLE* tables can be printed out.

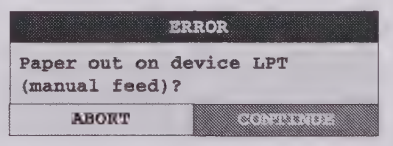
If the *FILE* option in the *HARDCOPY DEVICE* submenu of the *HARDCOPY SETTINGS* menu is selected then, upon pressing *HARDCOPY START*, the file name to which the output data are to be written is requested. For this an entry field is opened for entering the file name. If no external keyboard is connected, the help line editor is activated.

If the *START* key is pressed again while a print job is in progress, a new print job will be started directly after completion of the first one. It is not possible to process more than two hardcopies at the same time. With *START* pressed again, the following warning appears on the display screen:



Pressing the *OK* key causes the active print jobs to be interrupted. Selecting *CANCEL* erases the warning and the print job continues.

While a print job is in progress, problems may occur in the output device. If, while printing, the output device issues a PAPER OUT message, i.e., no more paper is available, the user will be prompted by the following message



to load paper into the output device. The print job will then be either continued (CONTINUE selected) or aborted (ABORT selected).
Similar SYSTEM MESSAGES appear, e.g., if the IEC Bus address of the printer is incorrectly set , the printer does not respond, etc.

Switchover between b/w and coloured printouts is possible with softkey *COLOR ON/ OFF* provided that the printer connected is able to output such prints. The colours of the printout correspond exactly to those of the screen, ie a red trace will be output in red.

To change the colours of the objects on the printout, the screen colours have to be changed correspondingly in menu *DISPLAY*, submenu *CONFIG DISPLAY*. One exception is the colour of the background and the colour of the diagrams. The output background is always white irrespective of the screen colour and the diagrams are always black.
If several traces are to be output one after the other on the same sheet different colours can be chosen for each trace with the aid of softkey *TRC COLOR AUTO INC* (Trace Color Auto Increment).

2.6.2 Printing Configuration – *SETTINGS* Key

HARDCOPY SETTINGS menu:

The *SETTINGS* key opens the menu to define the output configuration for diagrams and measurement curves to the various output channels, e.g., printer, plotter or files.

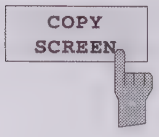
The recommended procedure for configuring the output data is as follows:

- Configure the desired output device and select the interface over which the output is to take place by using the *HARDCOPY DEVICE* soft key.
- Select the display items to be printed via the *COPY SCREEN, COPY TRACE soft keys.*
- Select between coloured and b/w printouts via softkeys *COLOR ON/ OFF* and *TRC COLOR AUTO INC*
- Enter commentary applicable to the diagram or add a title for the overall print-out by using the *ENTER TEXT* soft key.
- Select the page format (*QUADRANT, FULL PAGE*) through use of the *SELECT QUADRANT* soft key.

The *COPY SCREEN, COPY TRACE* and *COPY TABLE* soft keys are selection switches, i.e., only one function can be enabled at any one time. The push buttons are used for selection only and do not initiate a print job. The actual printing of data is initiated by the *HARDCOPY START* key.

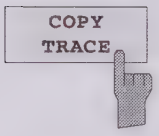
2.6.2.1 Selection of Displayed Elements and Colour Settings

HARDCOPY SETTINGS menu:

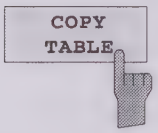


With softkey *COPY SCREEN* the output of test results is selected.

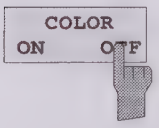
All the diagrams, traces, markers, marker lists, display lines, limit lines etc. are printed out as long as they are displayed on the screen. All the softkeys, tables and open data entry fields are not printed out. Moreover, comments, title, date, and time entered at the bottom margin of the printout are output. The logo appears at the top left of the printout.



Using the *COPY TRACE* soft key, all curves visible on the display screen are printed out without auxiliary information. Specifically, no markers or display lines are printed.

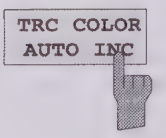


Using the *COPY TABLE* soft key, all tables visible on the display screen are printed out.



With softkey *COLOR ON/ OFF* a coloured or b/w printout can be selected.

After having changed the printer driver or the hardcopy device (in submenu, *HARDCOPY SETTINGS*) the softkey is automatically switched to *ON*.
One exception is printer driver HP PCL4 which only supports b/w printouts. In this case, the softkey cannot be operated.

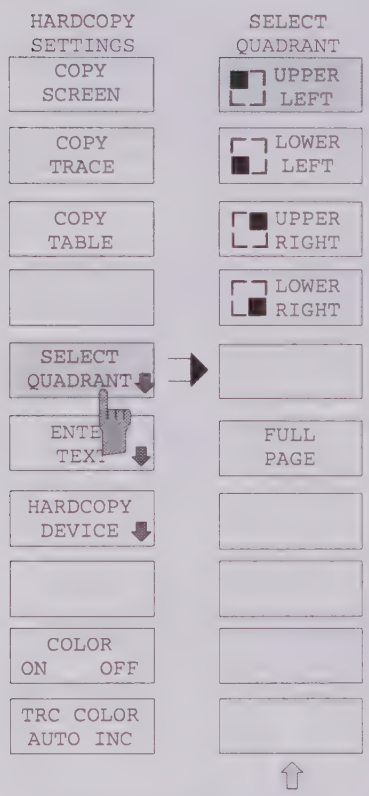


Softkey *TRC COLOR AUTO INC* automatically switches the colours of the traces on to the next printout. On the second printout, trace 1 has the colour of trace 2, trace 2 the colour of trace 3 etc. The fourth printout starts with the first colour. With the softkey switched off, the colours of the traces are reset to their original state.

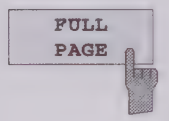
When changing the printer driver or the hardcopy device (both in submenu *HARDCOPY SETTINGS*) as well as the selection b/w printout (softkey *COLOR ON/ OFF* in position *OFF*), softkey *TRC COLOR AUTO INC* is switched off.

2.6.2.2 Selection of Hardcopy Format

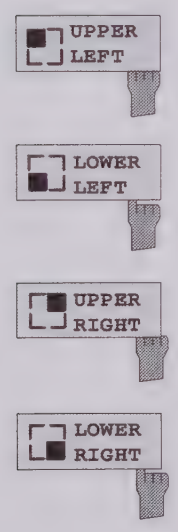
HARDCOPY SETTINGS-SELECT QUADRANT submenu:



With the functions of the *SELECT QUADRANT* menu, the location of the display screen graphics on the printed page can be selected.



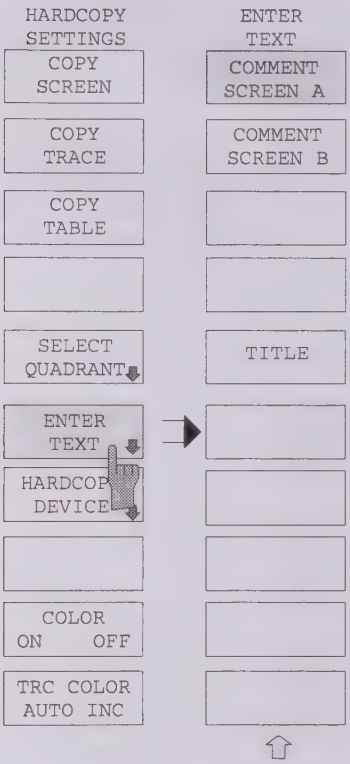
The *FULL PAGE* soft key switches quadrant printing off, i.e., printing now takes place at full size. The information as to which quadrant was last selected is also lost. *FULL PAGE* is the default setting.



The *UPPER LEFT, LOWER LEFT* as well as *UPPER RIGHT, LOWER RIGHT* soft keys select the page quadrants where the printed data will be positioned. In this case, the actual size of the data printed on the page is reduced to 25% of normal size. This reduction is independent of how the graphics are distributed on the display screen. Thus, for two measurement windows (*SPLIT SCREEN*), both measurement diagrams shown on the display are placed in the chosen quadrant. Thus, up to a maximum of 8 measurement windows can be printed on one page. (4 print commands for a *SPLIT SCREEN* display, each to a different quadrant)

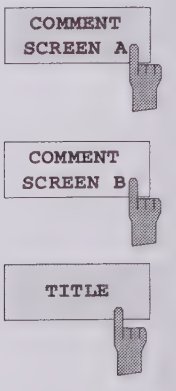
2.6.2.3 Entry of Comment Text

HARDCOPY SETTINGS-ENTER TEXT submenu:



With the functions of the *ENTER TEXT* menu, commentary for individual windows can be entered. The comment text appears in the print-out, but does not appear on the display screen.

If a comment is not to appear on the printout, it has to be deleted. By pressing *PRESET,* all comments will be deleted.

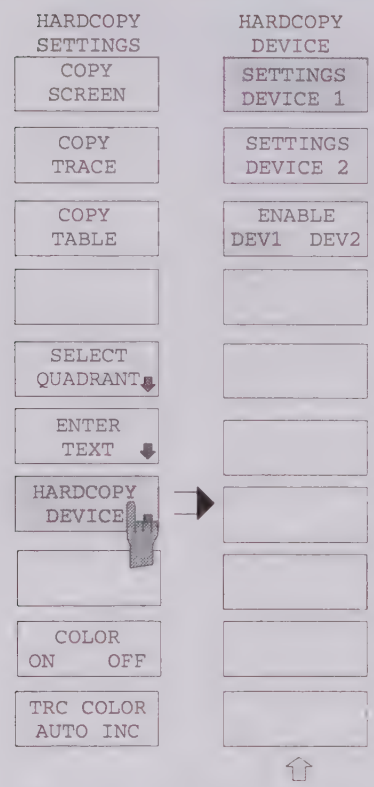


The *COMMENT SCREEN A* soft key opens an entry field in which a comment of two lines (60 characters per line) can be entered pertinent to the applicable window. If the user enters more than 60 characters, the excess characters appear on the second line on the print-out. Note: at any point, a manual line-feed can be forced by entering the @ character. The commentary is printed below the corresponding diagram. The *COMMENT SCREEN B* key has the same effect in measurement window 2.

The *TITLE* soft key activates a single line entry box for entering a title for the complete print-out with a maximum of 60 characters.

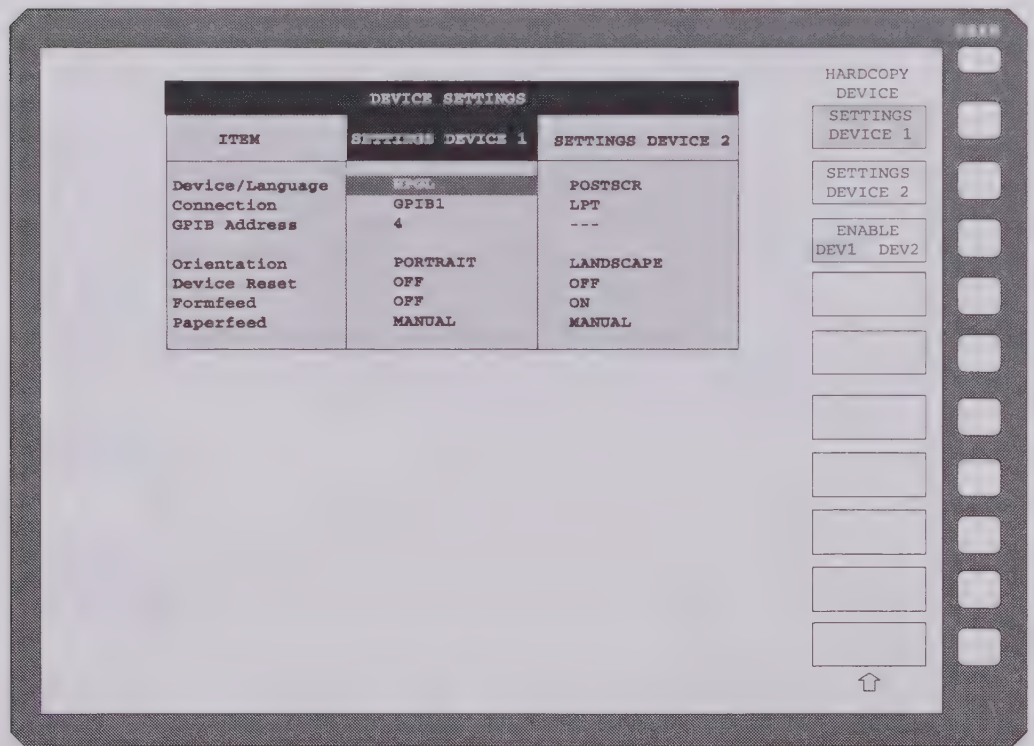
2.6.2.4 Selection and Configuration of the Output Device

HARDCOPY SETTINGS-HARDCOPY DEVICE submenu:



The *HARDCOPY DEVICE* soft key switches to the sub-menu which is used for the selection/configuration of the two output devices and for the connection of the devices to an output medium.

When the sub-menu is called, the corresponding table is simultaneously displayed. The *SETTINGS DEVICE 1* soft key is active and the selection bar is located at the *DEVICE/LANGUAGE* line in the corresponding column of the table.



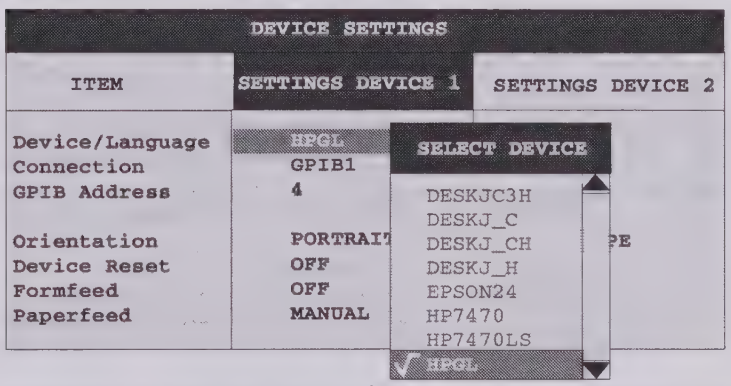
The FSE permits two different output devices to be configured. One of the devices is defined as the active device and can be used for hardcopies.

After calling the menu, the *SETTINGS DEVICE 1* soft key is active and permits the selection and configuration of the output device DEVICE 1. The selection bar is placed the corresponding column of the table. The *SETTINGS DEVICE 2* soft key is used to configure DEVICE 2.

The actual selection of the active output device takes place with the *ENABLE DEV1 DEV2* soft key in the *HARDCOPY DEVICE* sub-menu.

Device/Language

The selection of the output device/language for DEVICE 1 and DEVICE 2 is made in this line.



Sequence, number and name of available devices depends on the driver files stored on the harddisk:

Data format for printout on a plotter

HPGL	standard HPGL format
HPGL_LS	output of the traces with variable Line_styles
HP7470	plotter hp7470 (reduced HPGL format)
HP7470LS	special HP7470format allowing output of the traces with variable Line_styles

Data format for HP-deskjet series

DESKJ	black/white
DESKJ_H	black/white, high resolution
DESKJC3:	Color (3 color cartridges only) e. g. Deskjet 500)
DESKJC3H:	Color (3 color cartridges only), high resolution
DESKJ_C:	Color (3 color cartridges + black cartridge) e. g. Deskjet 560)
DESKJ_CH:	Color (3 color cartridges + black cartridge) , high resolution

Data format for a 24-pin printer

EPSON24	data format for Epson-compatible 24-needle printers, black/white, e. g. Epson LQ-series, R&S PDN
EPSON24C	data format for Epson-compatible 24-needle color printers, e. g. Epson Stylus Color, R&S PDN Color

Data formats for laser and ink-jet printers

HPPCL4	black/white with 300DPI resolution
HPPCL4HI	black/white, high resolution
HPPCL5	black/white with 300DPI resolution
LASERJ	data format for HP-laserjet starting with series III
PCL4	black/white
PCL4_H	black/white, high resolution
PCL4_C	color (3 color cartridges + black cartridge)
PCL4_CH	color (3 color cartridges + black cartridge), high resolution
PCL4_C3	color (3 color cartridges only)
PCL4_C3H	color (3 color cartridges only) , high resolution

Data format PostScript

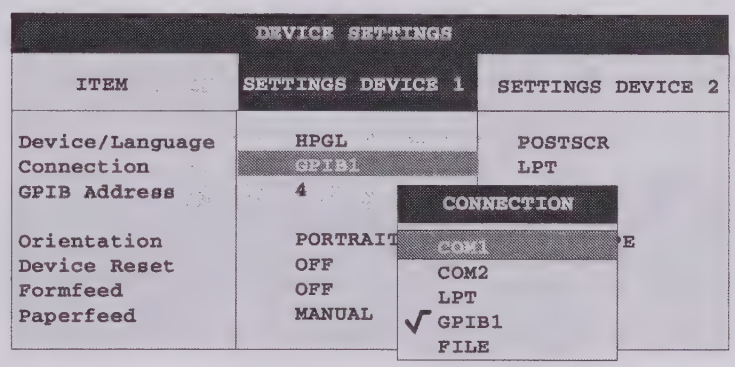
POSTSCR	a printer language (PostScript)

Data formats for output files

WMF	WINDOWS Metafile format
PCX	pixel graphics (e. g. Paintbrush)

Connection

The output channel to which the output device is connected is defined in this line.

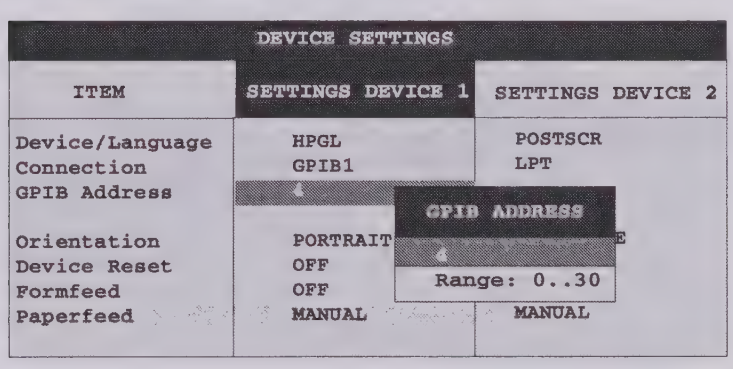


By selection of the *FILE* channel, the printer output can be sent to a file. In this case, pressing *HARDCOPY START* results in a prompt for the entry of a file name.

Output channels which, at first glance, do not appear to make sense, are also permitted because, in some cases, adapters are available which allow these devices to be connected to the interface. For example, adapters for RS232 ↔ IECBUS are available.

GPIB Address

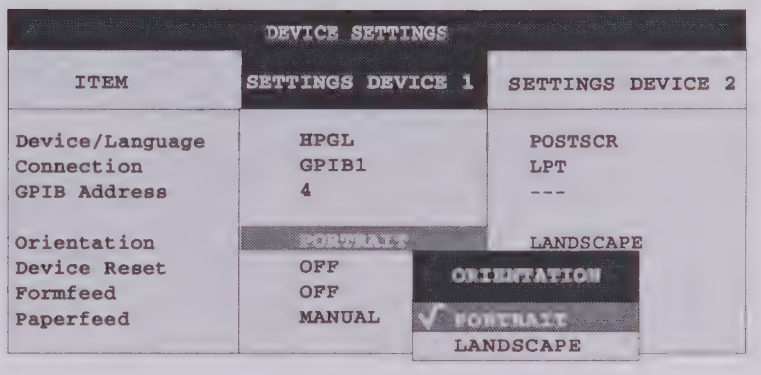
The IEC Bus address of the output device is set in this line .



The entry field in the GPIB line can only be opened when GPIB 1 was selected as an output channel in the connection line. Otherwise, this field is blank and can not be reached with the cursor keys.

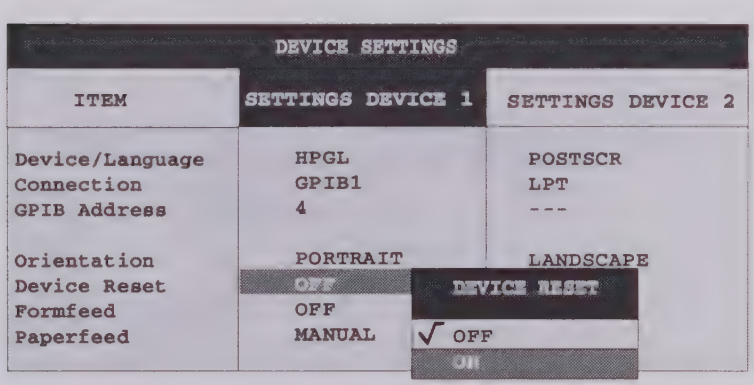
Orientation

In this line, the print format of the output page is set to either vertical (= PORTRAIT) or horizontal (= LANDSCAPE).



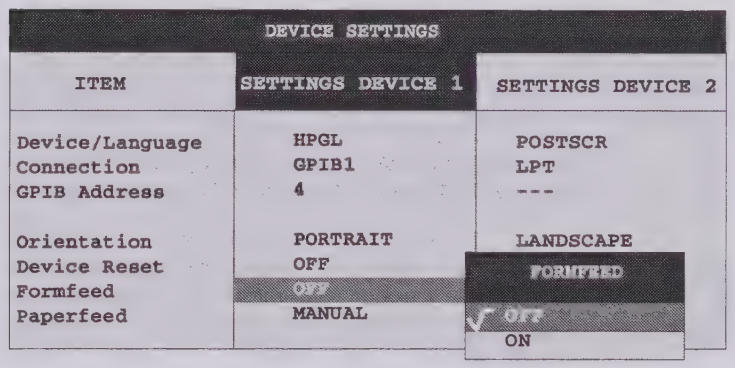
Device Reset

This line defines if the output device is to be reset (*DEVICE RESET ON*) before the actual print job is started or not (*DEVICE RESET OFF*). Resetting the output device causes, e.g., the loss of any settings which are made directly on the output device. For example, the definition of the drawing range for plotters or the print resolution for printers. The default setting at delivery is, therefore, *DEVICE RESET OFF*



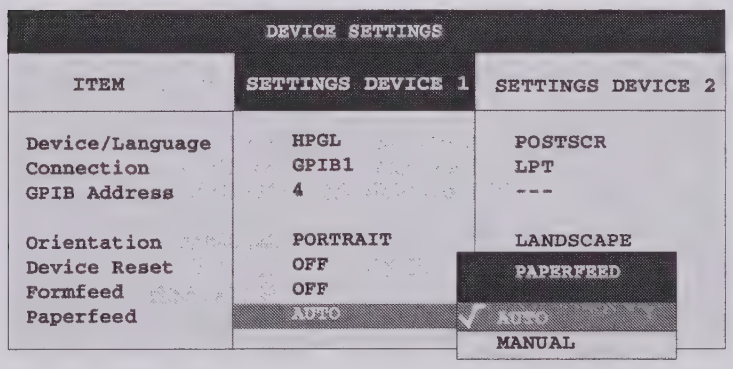
Formfeed

This line of the table determines whether a formfeed is made (*FORMFEED ON*) at the completion of the print job or not (*FORMFEED OFF*). The entry field in this line can only be selected when the output device permits a formfeed. Therefore, for plotters, it is set to OFF and cannot be changed.

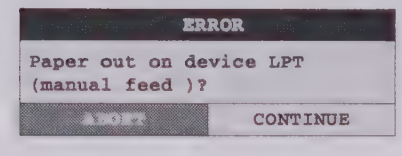


Paperfeed

This line of the table determines which paper holder is to be used for the print job. The input field of this line can only be selected when the output device permits a selection between endless and single-sheet paper types. Therefore, for plotters it is set to OFF and cannot be changed.



MANUAL FEED implies selection of the single-sheet mode so that, after pressing *HARDCOPY START*, the print job is stopped after each page and the user is prompted by the message



to load a new page in the output device. The print job is then either continued (CONTINUE selected) or stopped (ABORT selected).

The *ENABLE DEV1 / DEV2* soft key determines the active output device. The default output device is DEVICE 1, i.e., all output takes place on DEVICE 1.

2.7 Saving and Recalling Data Sets – *MEMORY* Key Group

The keys in the *MEMORY* group call the following functions:

- Functions for management of storage media (*CONFIG*). Included are among others functions for listing files, formatting storage media, copying, and deleting/renaming files.
- Storage/loading functions for storing (*SAVE*) instrument settings such as instrument configurations (measurement/display settings, etc.) and measurement results from working memory to permanent storage media, or to load (*RECALL*) stored data into working memory.

The FSE is capable of internally storing complete instrument settings with instrument configurations and measurement data in the form of data sets. The respective data are stored on the internal hard disk or, if selected, on a floppy. The hard-disk and floppy-disk drives are assigned logical names as usual in PC applications:

floppy disk	A:
hard disk	C:

In addition to the saving and recalling of complete instrument settings, it is also possible to save/recall subsets of settings. Configuration data and measurement values are stored in separate files. These files have the same name as the data set but however have a different extension. A data set thus consists of several files which have the same name but different extensions (see table 2.7-1).

When saving or loading a data set, the subsets which are to be saved or loaded can be selected in the corresponding menus. This makes it easy to reconstruct specific instrument settings.

When saving and loading data via the *SAVE* and *RECALL* menus, data subsets are selected in a table in the sub-menu *SEL ITEMS TO SAVE/RECALL*. The relationship between the designations in the table and the contents of the data subsets is shown in table 2.7-1.

The saved files of the data sets can be copied from one storage medium (e.g. drive C:) to another storage medium (e.g. drive A:) or to another directory using the functions found in the *MEMORY CONFIG* menu. File names and extensions must however not be changed. The relationship between the data subsets and the extensions is shown in table 2.7-1.

Table 2.7-1 Relationship between extensions, contents and designations of data subsets

	Extension	Contents	Designation in the table SEL ITEMS TO SAVE/RECALL
Configuration data:	.SET	current settings of the measurement hardware and the related title, if present	HARDWARE SETTINGS
	.LIN	data-point tables for the active limit lines	LINES
	.LIA	all limit lines	ALL LINES
	.CFG	current configuration of general instrument parameters	GENERAL SETUP
	.HCS	configuration for hardcopy output	HARDCOPY
	.TCI	Tracking generator settings (only with option FSE-B8/9/10/11)	SOURCE CAL
	.TS1 .TS2	Settings for source calibration (only with option FSE-B8/9/10/11)	SOURCE CAL
	.TC1 .TC2	Correction data for source calibration (only with option FSE-B8/9/10/11)	SOURCE CAL
	.TS	active transducer set	TRANSDUCER
	.TSA	all transducer sets	ALL TRANSDUCER
	.TF	transducer factor	TRANSDUCER
	.TFA	all transducer factors	ALL TRANSDUCER
	.COL	user-defined color settings	COLOR SETUP
Measurement results:	.TR1....4	measurement data trace 1 to trace 4	TRACE1...4

2.7.1 Configuration of Memory – *CONFIG Key*

MEMORY CONFIG menu:

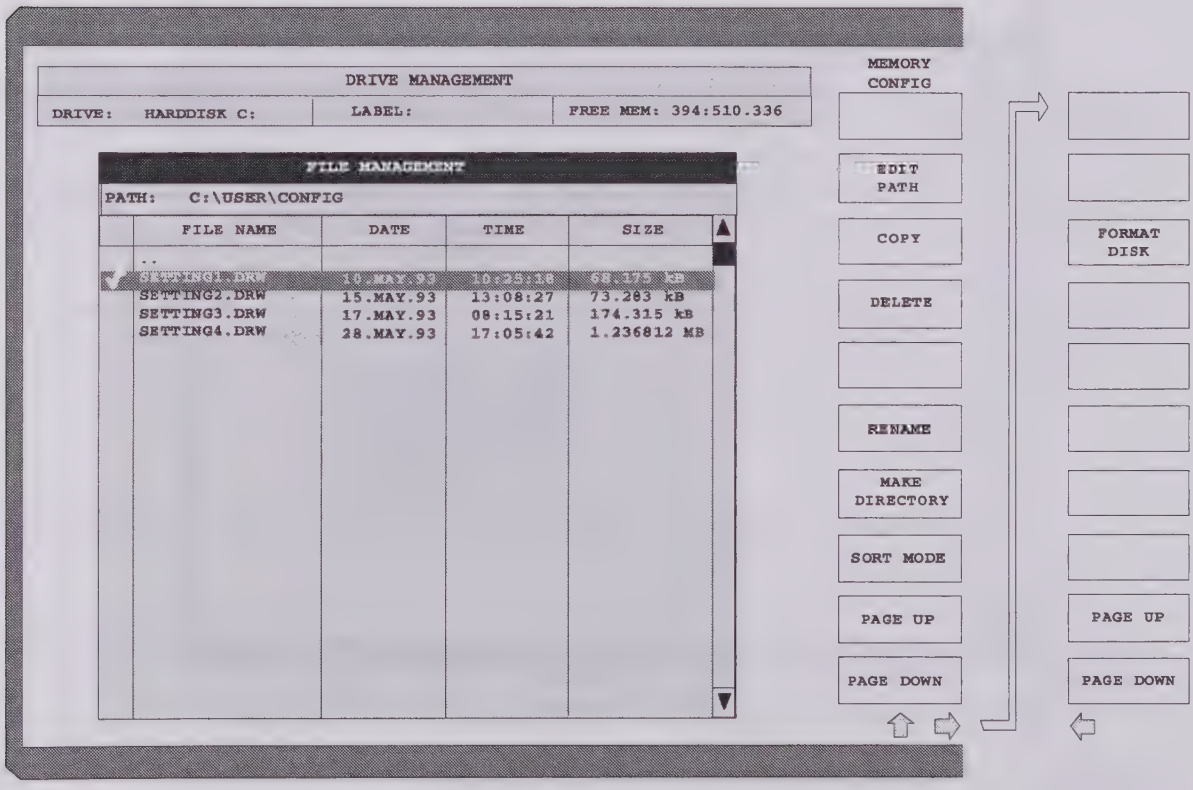
The *CONFIG* key opens a menu for managing storage media and files.

Table *Drive Management* displays the name and label of the storage medium as well as the available storage area.

Table *File Management* displays the files of the current directory and indicates if any subdirectories are present.

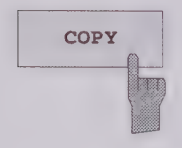
If a directory name is selected, the FSE automatically changes to this directory. Selection of the entry '..' moves the FSE to the next higher directory level.

Note: *It is not possible to change menus as long as a file operation is running.*



The *EDIT PATH* soft key activates the input of the directory which will be used in subsequent file operations.

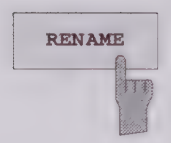
The new path is included in the *FILE MANAGEMENT* table.



The *COPY* soft key activates the input of the destination of the copy operation.

By entering a predefined disk drive (e.g. C:), a file can also be copied to another storage medium. The files/directories selected by the cursor are copied after the input is confirmed by pressing the *ENTER* key.

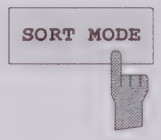
The *DELETE* soft key deletes the selected files.
To prevent accidental deletion of data, confirmation by the user is requested.



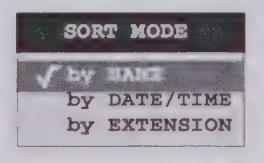
The *RENAME* soft key activates the entry of a new name for the selected file or directory.

The *MAKE DIRECTORY* soft key creates directories/sub-directories. Sub-directories are recommended for sorting files on the storage medium so that the structure is easier to comprehend.

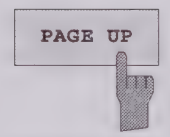
The entry of an absolute path name (e.g.; "\USER\MEAS") as well as the path relative to the current directory (e.g., "..\MEAS") is possible.



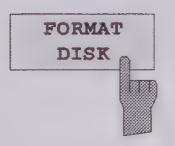
The *SORT MODE* soft key activates the selection of the criteria according to which the files listed in the *FILE MANAGEMENT* table may be sorted.



Directory names are located at the top of the list after the entry for the next higher directory level ("..").



The *PAGE UP* or *PAGE DOWN* soft key sets the *FILE MANAGEMENT* table to the next or the previous page.



The *FORMAT DISK* soft key formats diskettes located in drive A:.
To prevent accidental destruction of diskette data, confirmation by the user is requested.

2.7.2 Saving Data Sets – *SAVE Key*

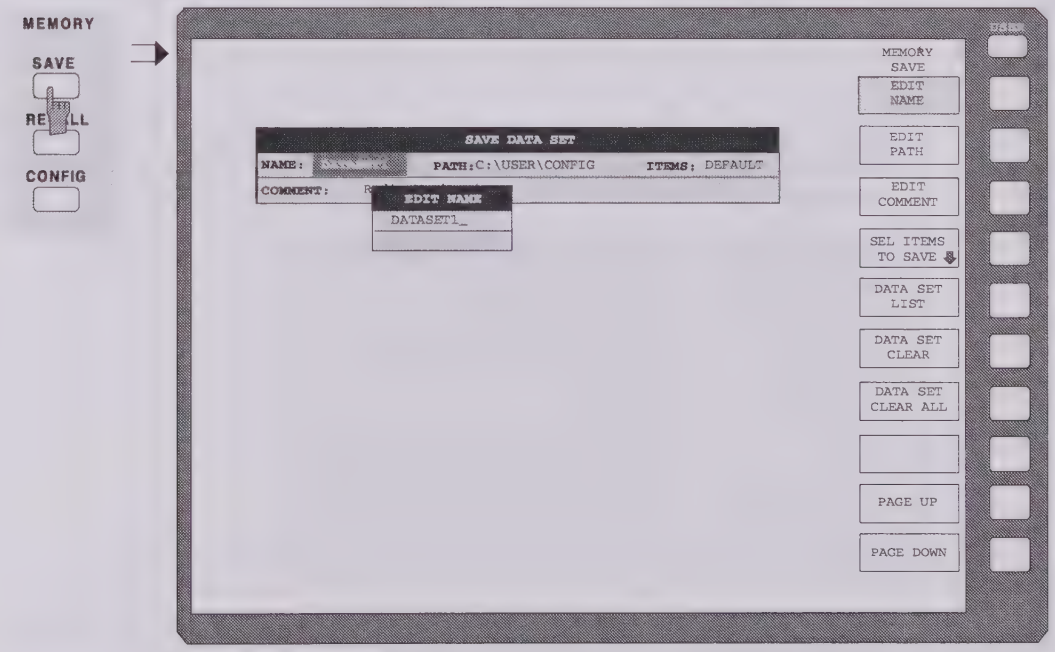
The *SAVE* key activates a menu which contains all functions necessary for saving instrument data.

- Entry of the name of the data set which should be saved. Confirmation of the entry initiates a save operation to store the data set.

  Data set names may contain both alphabetical and numeric characters, in the simplest case only numbers. The simplest example for the input of a data set name is illustrated by the following key strokes:

  <SAVE> <1> <units key>
- Entry of the directory in which the data set should be saved
- Input of data set description
- Selection of the data subsets to be saved (sub-menu SEL ITEMS TO SAVE)
- Indication of all available data sets
- Deletion of all available data sets

MEMORY SAVE menu



The *SAVE DATA SET* table shows the current settings regarding the data set:

Name	name of data set
Path	directory in which the data set will be saved
Items	indicates whether the default selection of the data subset (DEFAULT) or a user-defined selection (SELECTED) will be saved
Comment	Commentary regarding the data set

The *EDIT NAME* soft key for entering the name of the data set to be saved is activated automatically.

2.7.2.1 Selecting the Data Set for Storage

MEMORY SAVE menu:

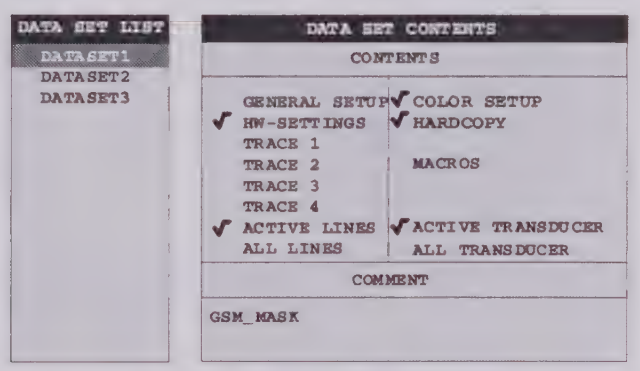
The *EDIT NAME* soft key activates the entry of the name of the data set to be saved.

Data entry is concluded by pressing one of the units keys which initiates a save operation to store the data set.

The *EDIT PATH* soft key activates the input of a directory name where the data sets are to be stored.

The *EDIT COMMENT* soft key activates the entry of commentary concerning the current data set. A total of 60 characters are available for this purpose.

The *DATA SET LIST* soft key opens the *DATA SET LIST/CONTENTS* table. In addition, the *DATA SET CLEAR* and *DATA SET CLEAR ALL* soft keys are displayed.



The *DATA SET LIST* column lists all of the data sets which are stored in the selected directory.

The *CONTENTS* and *COMMENT* lines in the *DATA SET CONTENTS* column indicate the saved data subsets and the commentary for the currently selected data set.

Note: *The current instrument configuration can be easily stored under the name of an existing data set:*

- *Press a units key after selecting a data set*

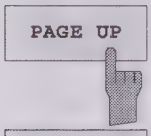
  The name and the selection of the data subsets for the currently selected data set will be placed in the SAVE DATA SET table. The DATA SET LIST table is closed and, instead, the entry field for the EDIT NAME function with the name of the selected data set is opened.

- *Press a units key.*
  The current instrument configuration is saved as a data set under this name.

The *DATA SET CLEAR* soft key deletes the marked data set.

The *DATA SET CLEAR ALL* soft key deletes all data sets in the current directory.

Since, in this case, all available data sets are lost, confirmation by the user is required.

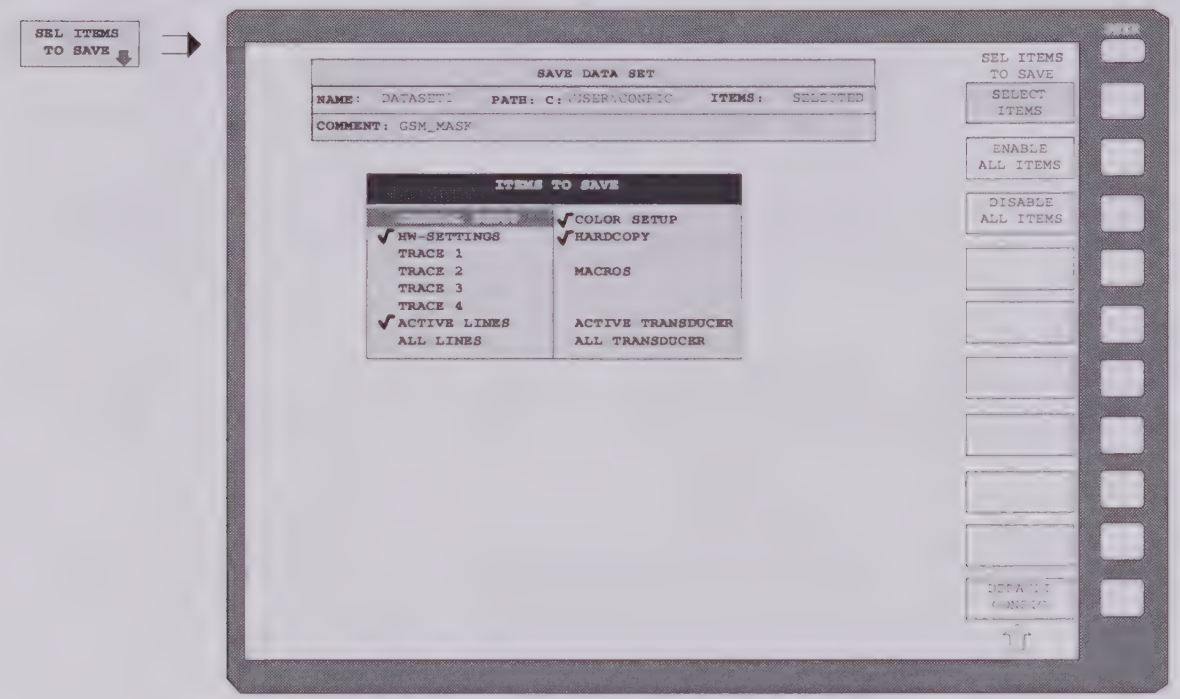


The *PAGE UP* or *PAGE DOWN* soft key sets the *DATA SET LIST* table to the next or previous page.

2.7.2.2 Selecting the Data subset for Storage

The *SEL ITEMS TO SAVE* soft key opens a sub-menu for selection of the data subsets.

MEMORY SAVE-SELECT ITEMS TO SAVE sub-menu:



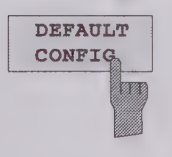
The *ITEMS TO SAVE* table displays the selectable data subsets:

General Setup	current configuration of general instrument parameters
HW-Settings	current measurement hardware settings
Trace1...4	measurement data trace 1 to trace 4
Active Lines	active limit lines
All Lines	all limit lines
Color Setup	user-defined color settings
Hardcopy Setup	configuration for hardcopy output
Macros	macros
Active Transducer	active transducer
All Transducer	all transducer

The *SELECT ITEMS* soft key moves the selection bar to the first line, left column of the table.

The *ENABLE ALL ITEMS* soft key marks all entries in the *ITEMS TO SAVE*. table.

The *DISABLE ALL ITEMS* soft key unmarks all entries in the *ITEMS TO SAVE* table.



The *DEFAULT CONFIG* soft key establishes the default selection of the data subset to be saved and outputs *DEFAULT* in the *ITEMS* field of the *SAVE DATA SET* table.

2.7.3 Recalling of Data Sets – *RECALL* Key

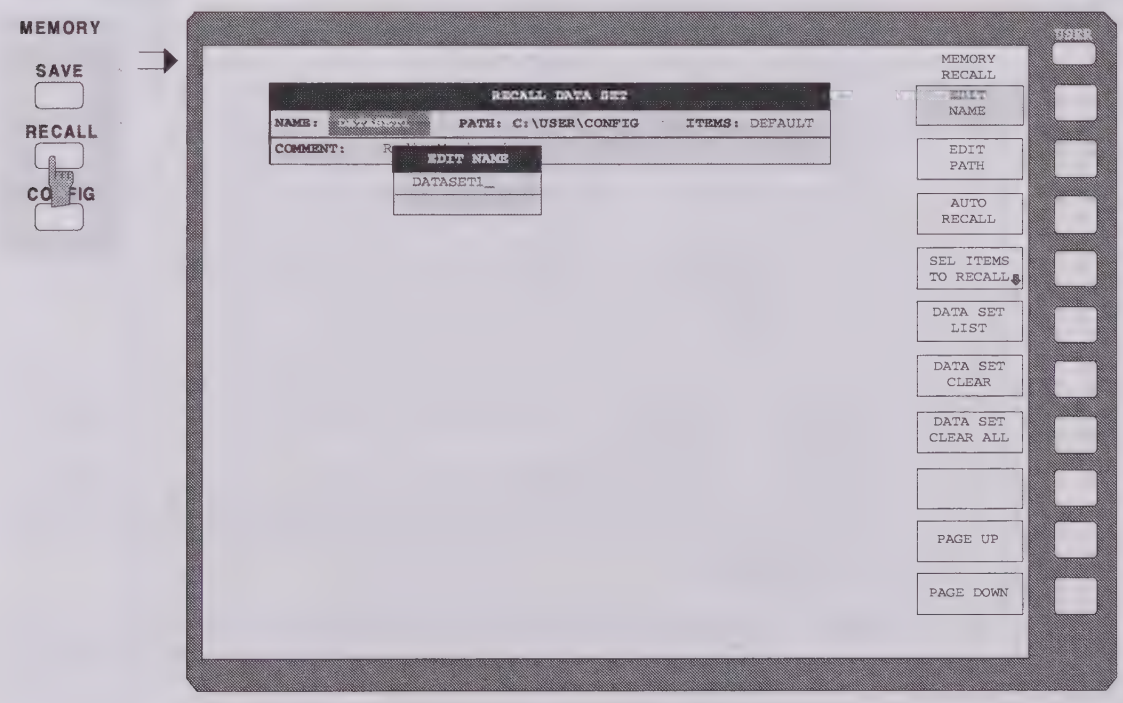
The *RECALL* key activates a menu which contains all functions necessary for recalling data sets.

- Entry of the name of the data set which should be recalled. Confirmation of the entry initiates a load operation to recall the data set.
- Entry of the directory in which the data set is stored
- Display of data set description
- Selection of a data set which will be automatically loaded upon power-up
- Indication of all available data sets
- Deletion of all available data sets
- Selection of the data subsets which should be loaded (configurations, measurement and calibration data, sub-menu SEL ITEMS TO RECALL)

Any settings not restored when data subsets are loaded will remain unchanged in the instrument. During recall operations, the FSE recognises which data subsets are present in the recalled data set and offers only the corresponding settings for selection in the *SELECT ITEM* sub-menu.

A new instrument data set can be easily constructed from several existing data sets: the desired data subsets are selected and recalled out of various data sets in several *RECALL* operations. When the desired configuration is completed, the new data set can be saved under a new name.

MEMORY RECALL menu:



The *RECALL DATA SET* table shows the current settings regarding the data set:

Name	name of data set
Path	directory in which the data set is located
Items	indicates whether the default selection of the data subset (DEFAULT) or a user-defined selection (SELECTED) will be loaded
Comment	commentary regarding the data set

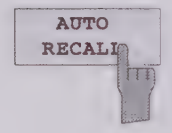
The *EDIT NAME* soft key for entering the name of the data set to be loaded is activated automatically.

2.7.3.1 Selecting the Data Set for Recalling

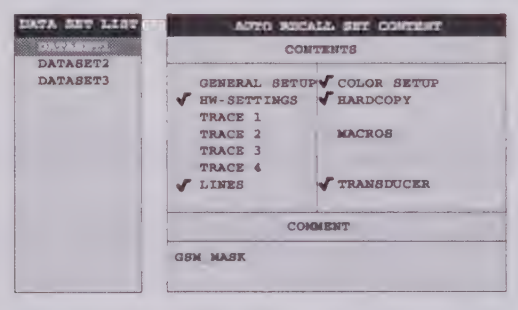
MEMORY RECALL menu:

The *EDIT NAME* soft key activates the entry of a data set name.
The data input is terminated by pressing one of the units keys which simultaneously initiates the data set recall operation.

The *EDIT PATH* soft key activates the entry of a directory name in which the data set is located.



The *AUTO RECALL* soft key activates the selection of a data set which is automatically loaded when the instrument is powered on. To this end the table *DATA SET LIST/CONTENT* is opened (analog to *DATA SET LIST).*



The *DATA SET LIST* column displays all data sets present in the selected directory.

The *CONTENTS* and *COMMENT* lines in the *AUTO RECALL CONTENTS* column indicate the saved data subsets and the commentary for the currently selected data set.

In addition to the data sets stored by the user, the data set *FACTORY*, which specifies the settings of the instrument before it was last switched off (Standby), is always present.

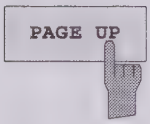
If a data set other than *FACTORY* is chosen then, at the time of instrument power on, the available data subsets of the selected data set are recalled. The data subsets which are not present in this data set are taken from the *FACTORY* data set.

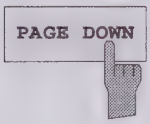
Note: *The specified data set is also loaded upon PRESET if AUTO RECALL is active. The preset settiongs can thus be arbitrarily modified.*

see Chapter "Saving Data Sets"

see Chapter "Saving Data Sets"

see Chapter "Saving Data Sets"



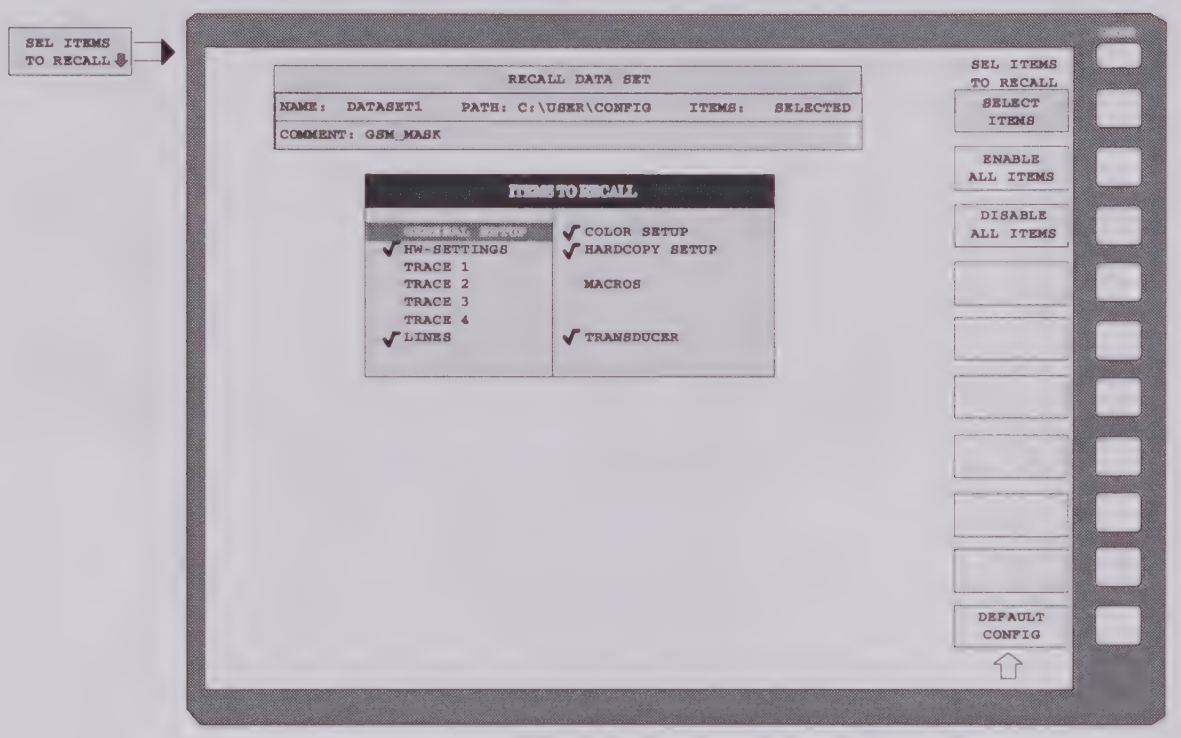


The *PAGE UP* or *PAGE DOWN* soft key sets the *DATA SET LIST* table to the next or previous page.

2.7.3.2 Building a Data Set

The *SEL ITEMS TO RECALL* soft key opens a sub-menu to select data subsets.

MEMORY RECALL-SELECT ITEMS TO RECALL sub-menu:



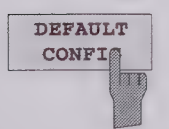
The *ITEMS TO RECALL* table displays the selectable data subsets:

General Setup	current configuration of general instrument parameters
HW-Settings	current measurement hardware settings
Trace1...4	measurement data trace 1 to trace 4
Lines	data point tables for the active limit lines
Color Setup	user-defined color settings
Hardcopy Setup	configuration for hardcopy output
Macros	macros
Transducer	transducer factor, transducer set

The *SELECT ITEMS* soft key activates the *ITEMS TO RECALL* table and sets the selection bar to the first line, left column of the table.

The *ENABLE ALL ITEMS* soft key marks all entries in the *ITEMS TO RECALL* table.

The *DISABLE ALL ITEMS* soft key unmarks all entries in the *ITEMS TO RECALL* table.



The *DEFAULT CONFIG* soft key establishes the default selection of the data subset to be recalled and outputs *DEFAULT* in the *ITEMS* field of the *RECALL DATA SET* table.

2.8 Macros – *USER Key*

The FSE menus are so designed that the analyzer can be easily applied to most of the usual measurement tasks with a minimum number of key operations. However, the *USER* menu also permits a tailored adaptation of any necessary setup and measurement functions needed for special applications. Here, a sequence of key operations, which may occur repeatedly, can be listed in the *USER* menu as a key macro, then stored in memory and recalled as required by the application.

2.8.1 Fundamentals

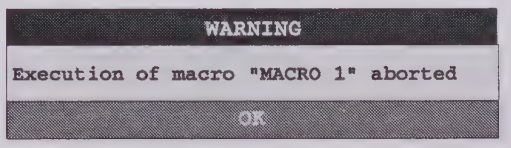
Macros are defined as arbitrary key sequences which need to be defined only once and then can be recalled as often as desired. Through the use of macros, often-needed measurement functions or instrument setups, which may require a large number of key operations, can be easily performed. The writing of macros is possible only under manual control. Macro generation is not possible under remote control (e.g. via the IEC Bus interface).

A total of 7 different macros can be programmed and assigned to the individual soft keys of the *USER* menu. Each macro has a title (arbitrarily defined by the user) which is also used as a label for the corresponding soft key. To indicate that a macro has not yet been programmed, the soft-key label appears in parenthesis (e.g. (MACRO 1)). After a key-sequence macro has been defined, the parenthesis are removed and the softkey is replaced by the titel specified by the user.

A macro is executed by pressing the corresponding soft key.

During execution of macros, the key actions are repeated in exactly the **same sequence** as they were programmed. The sequential execution of a macro may be interrupted by using the PAUSE instruction. As soon as a macro is interrupted, adjustments on the Unit Under Test (UUT) may be made, etc. The interrupted macro is allowed to continue by pressing *CONTINUE i*n the message window and is aborted by pressing ABORT.

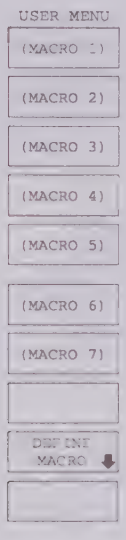
A running macro can be aborted by pressing the *LOCAL* key. At this time, the following message is displayed:



During the time a macro is executing, manual operations on the instrument are not possible, and the soft-key panel is disabled. After interruption or conclusion of a macro, the applicable soft-key panel is enabled (i.e., menu state at the conclusion of the macro).

2.8.2 Starting Macros

USER menu



The USER key opens a menu for selection and starting of macros. The macros can be defined in the *DEFINE MACRO* submenu.

The *MACRO 1* to *7* soft keys start the execution of the macros.

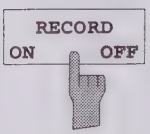
2.8.3 Defining Macros

In the *DEFINE MACRO* menu, all necessary soft keys needed for macro management are available. Included are functions for starting and ending macro programming, editing of a macro title, etc.

USER DEFINE MACRO menu

The *DEFINE MACRO* soft key calls the sub-menu to define the macros.

The *SELECT MACRO* soft key is active and opens the box to select the macro to be edited. In case no selection is made, *MACRO 1* is automatically selected.

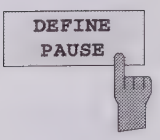


The *RECORD ON/OFF* starts or stops the recording of the macro.

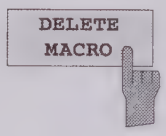
ON All key actions are recorded until the soft key is changed to *OFF* . To indicate that macro record is enabled, the enhancement label **MAC** is displayed.

The number of actions which can be stored in a macro is limited. If the limit is exceeded, the error message "Macro too long. Recording aborted" is output and the recording operation is aborted, however, the actions already recorded do remain stored.

OFF The recording is stopped. The key actions are stored under the macro chosen by the *SELECT MACRO* soft key.



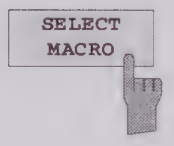
The *DEFINE PAUSE* soft key inserts a pause instruction into the macro sequence which is being recorded. A running macro will pause when it reaches this instruction, at which point settings on the unit under test could for example be made. *CONTINUE* in the message window is used to continue the macro execution.



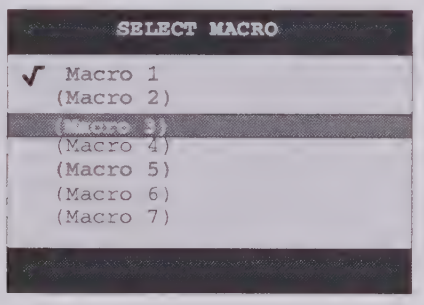
The *DELETE MACRO* soft key deletes the macro which was previously selected by the *SELECT MACRO* soft key. The soft key of the deleted title now carries its default label (*MACRO X*, X = macro number)

The *MACRO TITLE* soft key activates the entry of the title for the selected macro .

Because the macro title is used for labelling the corresponding soft key, a maximum of only 20 characters is allowed. All text after the 10 th character is written to the second line. However, entering the character @ forces a new line at any point in the soft key title.



The *SELECT MACRO* soft key open the selection box with a list of all 7 macros. All soft-key functions of this menu are related to this macro.



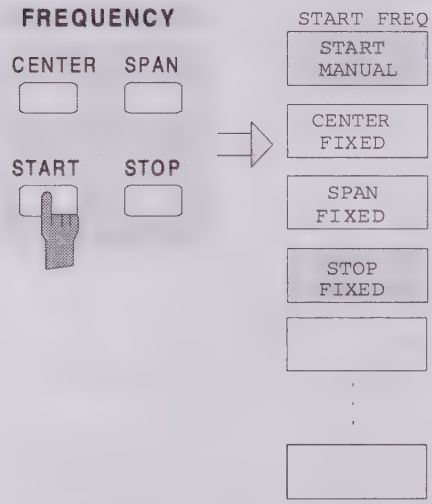
2.9 Analyzer Mode

2.9.1 Frequency and Span Selection – *FREQUENCY Key Group*

The *FREQUENCY* key group is used to specify the frequency axis of the active measurement window. The frequency axis can be defined either by the start and stop frequency or by the center frequency and span. For the case when two measurement windows (*SPLIT-SCREEN)* are displayed simultaneously, data entered are always related to the window selected in the *SYSTEM-DISPLAY* menu.
After pressing one of the keys *CENTER*, *SPAN*, *START* or *STOP*, the value of the corresponding parameter can be defined in the appropriate dialog window. At the same time, a soft key menu appears, which allows selecting the optional parameters.

2.9.1.1 Start Frequency – *START Key*

FREQUENCY – START menu:



The *START* key opens a menu which displays the various options for setting the start frequency of the sweep. The *START MANUAL* soft key is automatically active and opens the entry window for manual input of the start frequency. At the same time, the coupling of the parameters is set to *STOP FIXED*

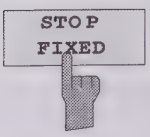
The *STOP FIXED, SPAN FIXED* and *CENTER FIXED* soft keys are mutually exclusive selection switches. Only one of these switches may be active at any one time. The frequency coupling selected by the soft keys defines which of the dependent parameters stop frequency, center frequency and span is to remain constant when a change in the start frequency is made.

The *START MANUAL* soft key activates manual entry of the start frequency.

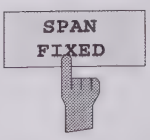
The allowed range of values for the start frequency is:

$0\ Hz <= f_{start} <= f_{max} - minspan/2$

f_{start}	start frequency
minspan	smallest selectable span)
f_{max}	max. frequency



If the *STOP FIXED* key is active, the stop frequency remains constant when the start frequency is changed. The center frequency is adjusted to the new frequency range. *STOP FIXED* coupling is the default setting.

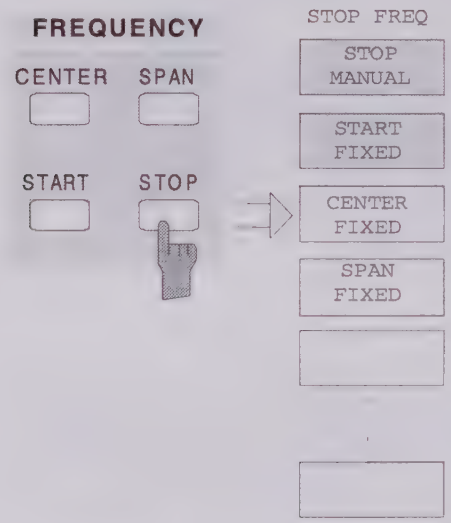


If the *SPAN FIXED* soft key is active, the span remains constant when the start frequency is changed. The stop frequency is adjusted to the new frequency range.

If the *CENTER FIXED* soft key is active, the center frequency remains constant when the start frequency is changed. The stop frequency is adjusted to the new frequency range.

2.9.1.2 Stop Frequency – *STOP Key*

FREQUENCY – STOP menu:



The *STOP* key opens a menu which displays the various options for setting the stop frequency of the sweep .

The *STOP MANUAL* soft key is automatically active and opens the entry window for manual input of the stop frequency. At the same time, parameter coupling is set to *START FIXED*.

The *START FIXED, CENTER FIXED* and *SPAN FIXED* soft keys are mutually exclusive selection switches. Only one switch can be active at any one time. The soft keys are used to select the frequency coupling. The frequency coupling defines which of the dependent parameters start frequency, center frequency or span is to remain constant when the stop frequency is changed.

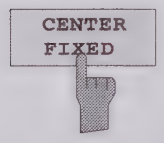
The *STOP MANUAL* soft key activates the manual entry window for the stop frequency.

The allowed range of values for the stop frequency is:

$minspan \leq f_{stop} \leq f_{max}$

f_{stop}	stop frequency
minspan	smallest selectable span (10Hz)
f_{max}	max. frequency

If the *START FIXED* soft key is active, the start frequency remains constant when the stop frequency is changed. The center frequency is adjusted to the new frequency range. The *START FIXED* coupling is the default setting.

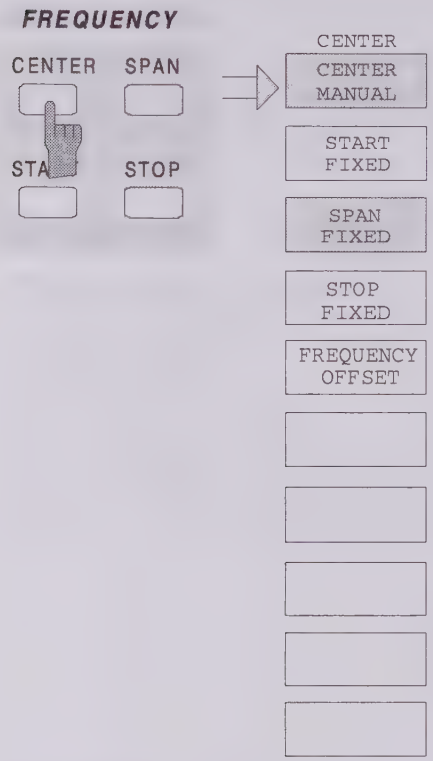


If the *CENTER FIXED* soft key is active, the center frequency remains constant when the stop frequency is changed. The start frequency is adjusted to the new frequency range.

If the *SPAN FIXED* soft key is active, the span remains constant when the stop frequency is changed. The start frequency is adjusted to the new frequency range.

2.9.1.3 Center Frequency – *CENTER Key*

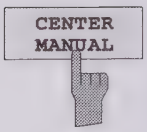
FREQUENCY – CENTER menu:



The *CENTER* soft key opens a menu which displays the various options for setting the center frequency of the sweep.

The *CENTER MANUAL* soft key is automatically active and opens the entry window for manual input of the center frequency. At the same time, the coupling of the parameters is set to *SPAN FIXED*.

The *START FIXED, STOP FIXED* and *SPAN FIXED* soft keys are mutually exclusive selection switches. Only one switch can be active at any one time. The soft keys are used to select the frequency coupling. The frequency coupling defines which of the dependent parameters start frequency, stop frequency or span remains constant when the center frequency is changed.



The *CENTER MANUAL* soft key activates the manual entry window for entering the center frequency.

The allowed range of values for the center frequency is:

for the frequency domain (span > 0):

$0\ Hz <= f_{center} <= f_{max} - minspan/2$

and for the time domain (span = 0)

$0\ Hz \leq f_{center} \leq f_{max}$

f_{center}	center frequency
minspan	smallest selectable span (10Hz)
f_{max}	max. frequency

If the *SPAN FIXED* soft key is active, the span remains constant when the center frequency is changed. The start and stop frequency are adjusted to the new frequency range. *SPAN FIXED* coupling is the default setting.

If the *START FIXED* soft key is active, the start frequency remains constant when the center frequency is changed. The span is adjusted to the new frequency range.

If the *STOP FIXED* soft key is active, the stop frequency remains constant when the center frequency is changed. The span is adjusted to the new frequency range.

The *FREQUENCY OFFSET* soft key activates the entry window for an arithmetical frequency offset which is added to the frequency axis labelling. The allowable range of input values is -100 GHz to 100 GHz. The default setting is 0 Hz.

2.9.1.4 Center Frequency Step Size

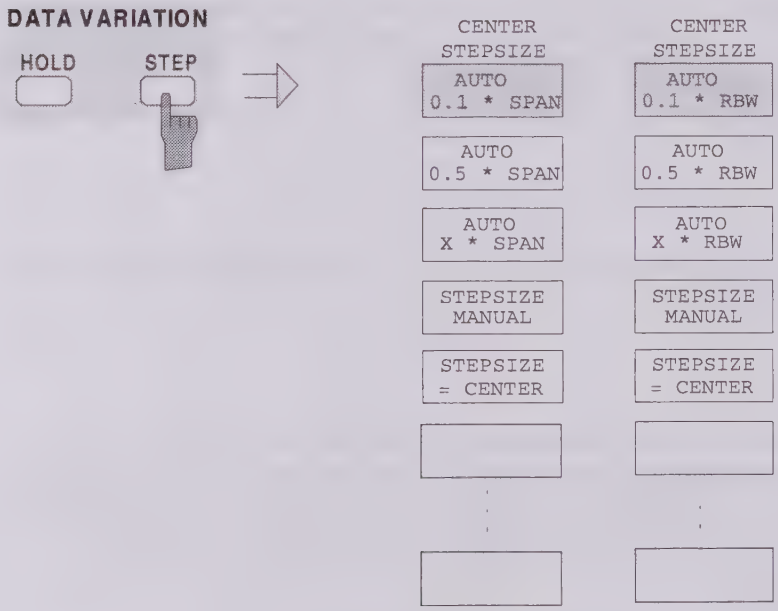
The *STEP* key in the *DATA VARIATION* key group opens a menu for setting the step size of the center frequency. The step size can be coupled to the span (frequency domain) or the resolution bandwidth (time domain) or it can be manually set to a fixed value.

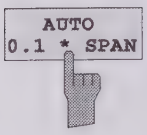
In order to change the step size, the entry window for the center frequency must already be active. After pressing the *STEP* key, the *CENTER STEP* menu appears. The soft keys are presented according to the selected domain (frequency or time).

The soft keys are mutually exclusive selection switches. Only one switch can be active at any one time.

Control is returned to the *FREQUENCY CENTER* menu via the menu key.

DATA VARIATION - STEP menu for span ≠ 0 for span = 0

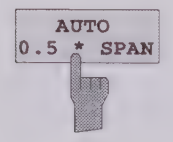




Frequency domain: The *AUTO 0.1 * SPAN* soft key sets the step size of the center frequency entry to 10% of the span.

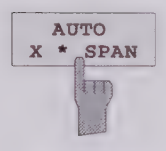
Time domain: The *AUTO 0.1 * RBW* soft key sets the step size of the center frequency entry to 10% of the resolution bandwidth

*AUTO 0.1 * RBW* is the default setting.



Frequency domain: The *AUTO 0.5 * SPAN* soft key sets the step size of the center frequency entry to 50% of the span.

Time domain: The *AUTO 0.5 * RBW* soft key sets the step size of the center frequency entry to 50% of the resolution bandwidth



Frequency domain: The *AUTO X * SPAN* soft key activates the entry of the factor defining the center frequency step size as a % of span.

Time domain: The *AUTO X * RBW* soft key activates the entry of the factor defining the center frequency step size as a % of the resolution bandwidth.

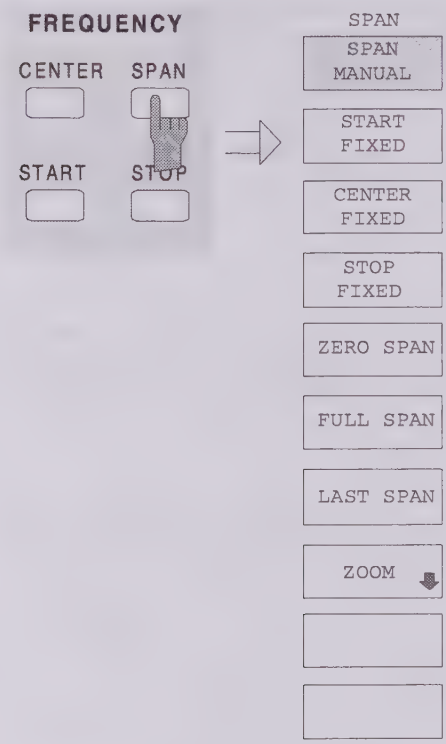
Values between 1 and 100% in steps of 1% are acceptable. The default setting is 10%.

The *STEPSIZE MANUAL* soft key activates the entry window for the input of a fixed step size.

The *STEPSIZE = CENTER* soft key sets the step size coupling to *MANUAL* and the step size to a value equal to the center frequency. This function is especially useful during measurements of the signal harmonic content, because, when entering the center frequency, the center frequency of another harmonic is selected with each stroke of the *STEP* key.

2.9.1.5 Frequency Span – *SPAN Key*

FREQUENCY – SPAN menu:



The *SPAN* key opens a menu which displays various options for the selection of sweep span.

The *SPAN MANUAL* soft key is automatically active and opens the entry window for manual input of the span. At the same time, the parameter coupling is set to *CENTER FIXED.*

The *START FIXED, CENTER FIXED* and *STOP FIXED* soft keys are mutually exclusive selection switches. Only one switch can be active at any one time. The frequency coupling is selected with these soft keys. The frequency coupling defines which of the dependent parameters start frequency, center frequency or stop frequency is to remain constant when the span is changed

The *SPAN MANUAL* soft key activates the manual entry of the span.

The allowed range of input values for span are:
time domain (span = 0):

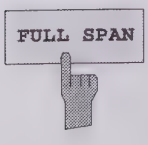
0 Hz

frequency domain (span > 0):

$$minspan \leq f_{span} \leq f_{max}$$

f_{span}	frequency span
minspan	smallest selectable span (10Hz)
f_{max}	max. frequency

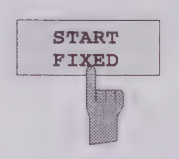
The *ZERO SPAN* soft key sets the span value to 0 Hz. The x axis becomes the time axis. The axis labelling corresponds to the sweep time (on the left, 0 ms, on the right, the current sweep time (SWT)).



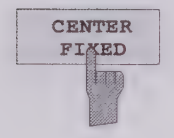
The *FULL SPAN* soft key sets the span value to the maximum span of the FSE.

The *LAST SPAN* soft key switches the instrument between a detailed measurement (given: center frequency and span) mode and an overview measurement (*FULL SPAN*) mode.

The *FULL SPAN* soft key modifies the center frequency as well as the selected span. The *LAST SPAN* soft key cancels this change.



If the *START FIXED* soft key is activated, the start frequency remains constant when the span is changed. The center and stop frequency are adjusted to the new span.

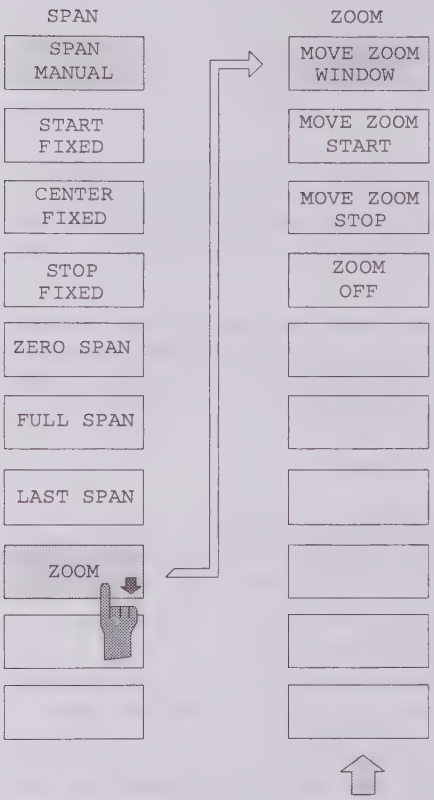


If the *CENTER FIXED* soft key is activated, the center frequency remains constant when the span is changed. The center and stop frequency are adjusted to the new span. The *CENTER FIXED* coupling is the default setting.

If the *STOP FIXED* soft key is activated, the stop frequency remains constant when the span is changed. The center and start frequency are adjusted to the new span.

2.9.1.6 Display Zoom

FREQUENCY SPAN- ZOOM submenu:



The *ZOOM* soft key activates the zoom mode and opens a sub-menu to define the zoom span.

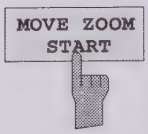
Two frequency lines, which show and define the frequency range to be zoomed, appear in the active measurement window when the zoom mode is switched on. The default setting is a zoom span of 10% to the left and 10% to the right of the center frequency. The zoomed display is shown in the second measurement window.
The settings for the second measurement window are taken from the original window. The second measurement window thus becomes the active measurement window and its settings can now be changed.

If only one window is active when the zoom function is selected, *SPLIT SCREEN* mode is automatically switched on.

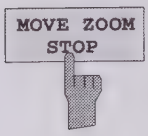
The zoom span can be edited by using the soft keys of the sub-menu to change the position of the frequency lines.

The soft key ZOOM OFF switches off the zoom.

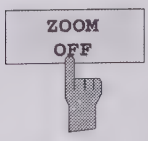
The *MOVE ZOOM WINDOW* soft key shifts the full zoom window. The window can shifted until the upper frequency line has reached the stop frequency or the lower frequency line has reached the start frequency of the original window.



The *MOVE ZOOM START* soft key shifts the lower frequency line. Thus, the start frequency of the zoomed display can be modified. The frequency line can be shifted down to the start frequency of the original window or up to the upper frequency line (= zero span).



The *MOVE ZOOM STOP* soft key shifts the upper frequency line. Thus, the stop frequency of the zoomed display can be modified. The frequency line can be shifted up to the stop frequency of the original window or down to the lower frequency line (= zero span).



The *ZOOM OFF* soft key switches the zoom function off and then returns control to the main menu.
The frequency lines for indicating the zoom range are deleted, *SPLIT SCREEN* mode remains active, the settings of both measurement windows are retained and the coupling of the two measurement windows is cancelled.

2.9.2 Level Display and RF Input Configuration – *LEVEL Key Group*

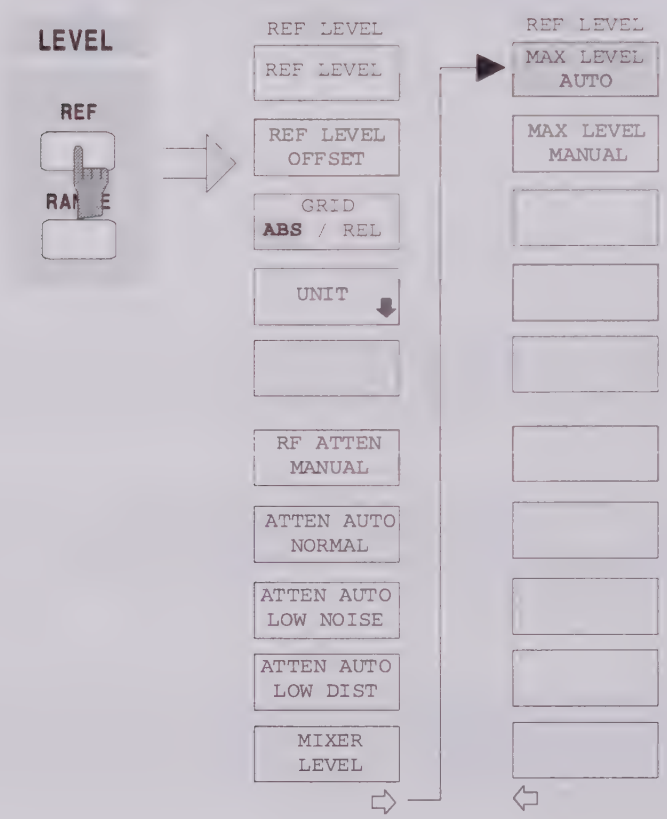
The *REF* and *RANGE* keys are used to set the reference level (= maximum RF input level, = overload limit), the maximum level (= upper grid level) , and the display range of the active window. The *INPUT* key sets the characteristics of the RF input (input impedance and input attenuation).

2.9.2.1 Reference Level – *REF* key

In addition to the reference level (maximum RF input level), the FSE provides a function to define a maximum level (uppermost grid line on the display):
For a spectrum analyzer, the upper boundary of the measurement diagram (maximum level) is also the limit of its dynamic range (reference level). This means, that a signal which goes beyond the upper grid line also overdrives the analyzer.

For compensation of frequency or antenna characteristics, transducer factors can be applied to increase the signal level. In this case, the calculated values can be above the reference level without actually being physically applied to the instrument. In order to display these signals on the grid, an upper grid level which is different from the reference level of the analyzer can be entered.

LEVEL REF menu:

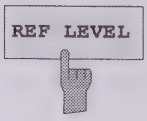


The *REF* key opens a menu to set the reference level and the input attenuation for the active measurement window .

The *REF LEVEL* soft key is automatically active with the menu called up and opens the entry window for manual input of the reference level.

At the same time various settings concerning the level and the attenuation display can be made.

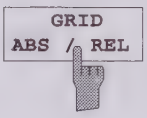
The functions for setting the attenuation are identical to those under the *INPUT* key and are described in Section 2.9.2.4.



The *REF LEVEL* soft key activates the entry of the reference level. The input is made in the currently active units (dBm, dBµV, etc.).

If the *MAX LEVEL MANUAL* softkey is active, a change of the reference level causes an equal amount of change in maximum level Thus, the separation between the overload limit of the analyzer to the upper grid edge remains the same. Thus, with only one entry, it is possible to make a change to the display and simultaneously to perform an adjustment to the amplifier.

The *REF LEVEL OFFSET* soft key activates the entry of an arithmetic offset (±200 dB in 0,1 dB steps) to the level. The offset is added to the measured level dependent upon the selected units. The scaling of the y axis is changed accordingly.



The *GRID ABS/REL* soft key switches between absolute and relative scaling of the level axis. *GRID ABS* is the default setting.

For absolute scaling the labelling of the level lines is referenced to the absolute value of the reference level.

For relative scaling, the upper line of the grid is always at 0 dB and the scale units are in dB. In contrast, the reference level is always displayed in the set units (dBm, dBµV,..).

The soft key is not displayed for setting *LIN / %* (linear scaling, labelling in %) in the *LEVEL-RANGE* menu since the % unit itself implies a relative scale.

The *MAX LEVEL MANUAL* and *MAX LEVEL AUTO* soft keys are mutually exclusive selection switches. Only one switch can be active at one time. The soft keys are used to select whether reference level and maximum level are identical or not:

When *MAX LEVEL AUTO* soft key is active, the reference level and maximum level are identical.
In this case, the reference level is displayed above the upper left corner of the grid in the corresponding function field.

MAX LEVEL AUTO is the default setting.

If the *MAX LEVEL MANUAL* soft key was active prior to pressing the *MAX LEVEL AUTO* soft key, the upper boundary of the grid is set to the reference level.

The *MAX LEVEL MANUAL* soft key activates the entry of the maximum level. The range of input values is ± 200dBm with 0.1 dB resolution.

If the *MAX LEVEL MANUAL* soft key is activated, the maximum level is displayed in addition to the reference level to the right above the grid.

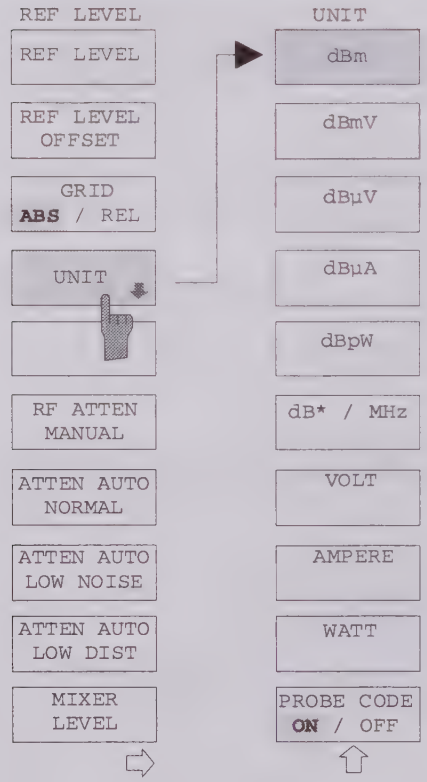
2.9.2.2 Display Units

In general, a spectrum analyzer measures the signal voltage at the RF input. The level display is calibrated in rms values of an unmodulated sine wave signal. In the initial state, the level is displayed at a power of 1 milliwatt (= dBm). Via the known input resistance of 50Ω, a conversion can be made to other units. The units dBm, dBµV, dBµA, dBpW, V, A and W are directly convertible and can be selected in the *REF UNIT* menu.
Units dB../MHz have a special status. They are applicable for broadband pulse signals. The measured pulse voltage or the pulse current is referred to 1 MHz bandwidth. This conversion is not useful for narrowband or sinewave signals.
If the antenna coded connector on the front panel is used, the coded unit there determines the possible display units. Connecting to the coded connector deactivates the settings of the *UNIT* menu.
By certain codings it is nevertheless possible to select a conversion of the unit in the menu. The dependencies between the unit of the antenna coded connector and the unit which is to be selected for the display are given in the soft key description.

The default coding defined by the connector can be switched off using the *PROBE CODE ON/OFF* soft key. In this case, the unit can be set with the corresponding unit soft keys (dBm, dBµV, ...) even if a coded connector is plugged in. The coded entries in the connector are then ignored.

Note: *The units dBµV/m and dBµA/m can only be set via the unit of a transducer or via the unit of the coded connector.*

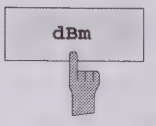
LEVEL REF UNIT submenu:



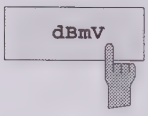
The *UNIT* soft key opens a sub-menu in which the desired units for the level axis can be selected and the coding of the antenna coded connector can be switched on and off.

The selected units are valid for both displays when two measurement windows are displayed.

The unit soft keys are mutually exclusive selection switches. Only one of these switches may be active at any one time.

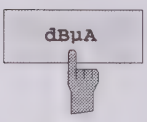


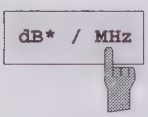
The *dBm, dBµV, dBmV, dBµA, dBpW* soft keys set the display units to the corresponding logarithmic units. The dBm unit is the default unit in analyzer mode.



The units *dBm, dBµV, dBmV, dBµA* cannot be selected when the coded antenna connector or the used transducer defines a unit.

Only for coding dB, the conversion to the desired units is permitted.





The *dB*/MHz* softkey activates/disactivates the display of results in units relative to the bandwidth. Those units can be derived from the logarithmic units *dBµV, dBµV/m, dBµA* and *dBµA/m.*

This leads to the following relative units:

dBmV ⇒ *dBmV/MHz*
dBµV ⇒ *dBµV/MHz*
dBµV/m ⇒ *dBµV/mMHz*
dBµA ⇒ *dBµA/MHz*
dBµA/m ⇒ *dBµA/mMHz*

Switching over is possible also if a coded antenna connector or a transducer fixes the unit to be used.

Conversion to 1 MHz is via the pulse bandwidth of the selected resolution bandwidth B_{imp} according to the following equation (example for *dBµV)* :

$$P\ /\ (dB\mu V\ /\ MHz) = 20 \cdot \log \frac{B_{imp}\ /\ MHz}{1MHz} + P\ /\ (dB\mu V),$$

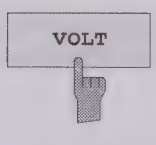
where
P = display level

The dBµV/MHz unit can be combined with the following coded connector or transducer units

dB (the unit dBµV/MHz remains)
µV/m (yields the display unit dBµV/mMHz)

analogous for dBµA/MHz:
dB and µA (the unit dBµA/MHz remains)

Other combinations are not allowed.

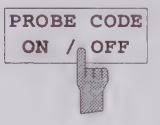


The *VOLT, AMPERE, WATT* soft keys set the display units to the corresponding linear units.

The units *VOLT, AMPERE, WATT* cannot be selected when the coded antenna connector or the transducer table defines one of the following as units:

- µV/m
- µA

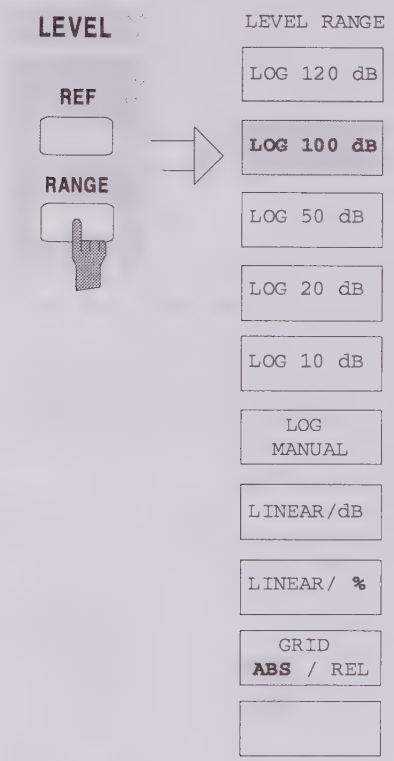
For coding dB, the conversion to the desired units is permitted.



The *PROBE CODE ON/OFF* soft key enables or disables the units defined by the coded connector.

2.9.2.3 Level Range – *RANGE* Key

LEVEL RANGE menu:



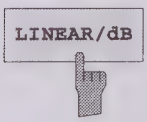
The *RANGE* key calls a menu in which the range, linear or logarithmic the display scale, absolute or relative and the level units for the active window can be selected.

The display range of the analyzer can be set in 10 dB steps from 10 to 200 dB. The default setting is 100 dB.

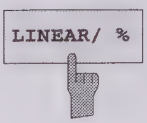
The most often used settings (120 dB, 100 dB, 50 dB, 20 dB and 10 dB) are each directly selectable by a soft key.
All other ranges are chosen with the *LOG MANUAL* soft key.

After pressing the *RANGE* key, the *LOG MANUAL* entry window is enabled if the display range is not set to *LIN*.

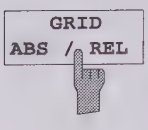
The *LOG MANUAL* soft key activates the entry of the level display range. Display ranges from 10 to 200 dB are allowed in 10-dB steps. Values which are not permissible are rounded to the next valid number.



The *LINEAR/dB* soft key switches the display range of the analyzer to linear scaling. The horizontal lines are labelled according to the selection *GRID ABS/REL* in dB* or *.



The *LINEAR/%* soft key switches the display range of the analyzer to linear scaling. The horizontal lines are labelled in %. The grid is divided into decades.



The *GRID ABS/REL* soft key switches between absolute and relative scaling of the level axis. *GRID ABS* is the default setting.

ABS The labelling of the level lines is referenced to the absolute value of the reference level.

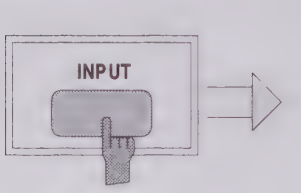
REL The upper line of the grid is always at 0 dB and the scale units are in dB. In contrast, the reference level is always displayed in the set units (dBm, dBµV,..).

The soft key is not displayed for setting *LIN / %* (linear scaling, labelling in %) since the % unit itself implies a relative scale.

2.9.2.4 RF Input Configuration – *INPUT* Key

In addition to manual entry of the input attenuation, the FSE provides an option which allows the RF attenuation, dependent on the selected reference level, to be automatically set. Thus, it is guaranteed that an optimum combination of RF attenuation and IF amplification is always used. For the automatic selection process, three modes are provided. The *AUTO LOW NOISE* mode selects the amplification/attenuation combination so that the display of noise on the FSE is at a minimum. The signal/noise ratio is maximised. The *AUTO LOW DISTORTION* mode is tuned for minimisation of the internally generated interference products. This causes, however, a lower signal/noise ratio. The *ATTEN AUTO NORMAL* mode is a compromise between low noise and low distortion.

INPUT menu:



The *INPUT* key opens the menu for configuring the RF input. It contains the input attenuator and mixer level for matching the RF input to the input signal.

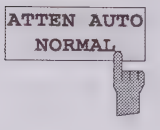
The *RF ATTEN MANUAL*, *ATTEN AUTO NORMAL*, *ATTEN AUTO LOW NOISE* and *ATTEN AUTO LOW* soft keys are mutually exclusive selection switches. only one can be active at any one time.

The *INPUT SELECT* soft key calls a submenu for selection of the input impedance.

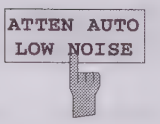
The *RF ATTEN MANUAL* soft key activates the entry of an attenuation factor independent of the reference level.

The attenuation can be set in 10 dB steps between 0 and 70 dB.
Other inputs will be rounded to the next lower integer value.

If the defined reference level cannot be set for the given RF attenuation, the reference level will be adjusted accordingly and the warning "Limit reached" will be output.



The *ATTEN AUTO NORMAL* soft key sets the RF attenuation automatically independent of the selected reference level.



The *ATTEN AUTO LOW NOISE* soft key sets the RF attenuation always 10dB lower than in the *RF ATTEN AUTO* mode. Therefore, for 10 dB RF attenuation, the maximum reference level is -10 dBm. For reference levels which are lower, at least 10 dB is always set (see above).

Setting Low Noise means that the indicated inherent noise level is low. This setting is recommended if signals with a low level have to be measured as the highest S/N ratio is then obtained.

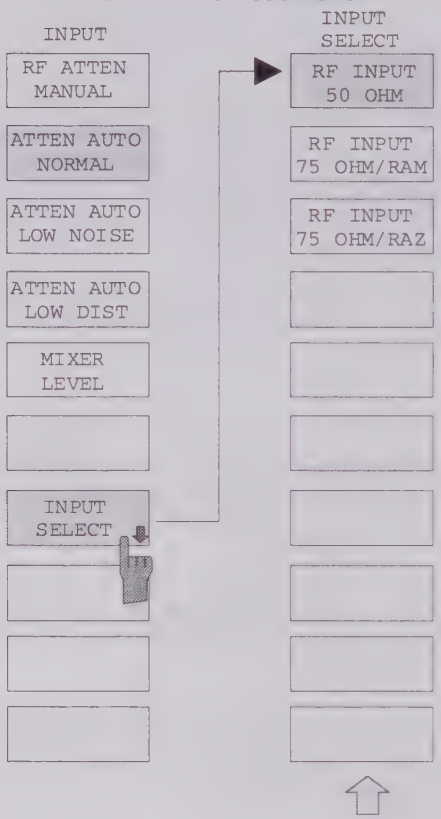
The *ATTEN AUTO LOW DIST* soft key sets the RF attenuation 10 dB higher than in *RF ATT AUTO* mode. This means that for 10 dB RF attenuation, the maximum reference level is -30 dBm (-40 dBm at the mixer).

This setting is recommended whenever a small signal is to be measured in the presence of larger signals. Here, the intermodulation-free range of the FSE is large and the internal distortion products are minimised.

The *MIXER LEVEL* soft key activates the entry of the maximum mixer level attainable for a given reference level. At the same time it enables soft keys *ATTEN AUTO LOW NOISE* and *ATTEN AUTO LOW DIST*.

Range of input values is -10 to -100 dBm

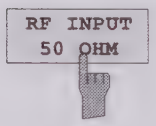
INPUT INPUT SELECT submenu:



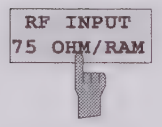
The *INPUT SELECT* soft key calls a submenu for selection of the input impedance of the RF input.

The basic setting is 50 Ohm. By connecting an impedance converter RAM or RAZ ahead, the 50-Ohm input can be transformed to 75 Ohm. FSE automatically takes the corresponding correction values for the level display into account.

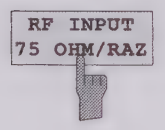
The soft keys used to select the input impedance are selection switches. Only one of them can be active at any one time



The *RF INPUT 50 OHM* soft key sets the input impedance to 50 Ohm (= default setting). All level indications are referenced to 50 Ohm.



The *RF INPUT 75 OHM/RAM* soft key sets the input impedance of the FSE to 75 Ohm including the matching element RAM. All level indications are referenced to 75 Ohm.



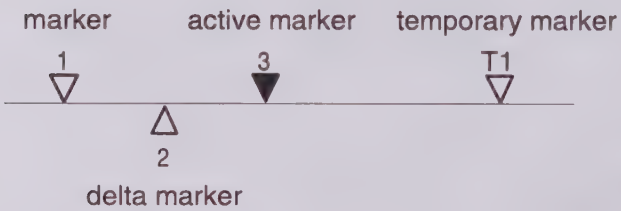
The *RF INPUT 75 OHM/RAZ* soft key sets the input impedance of the FSE to 75 Ohm including the matching element RAZ. All level indications are referenced to 75 Ohm.

2.9.3 Marker Functions – *MARKER Key Group*

The markers are used for marking points on measurement curves, reading out measurement values and for quickly selecting a display screen segment. Preselected measurement routines can be called by pressing a key in the marker menu. The FSE provides four markers and four delta markers per measurement window. The currently activated marker can be shifted with the cursor keys, the roll-key or the soft keys. The soft keys are defined according to the type of display representation selected (frequency or time domain).

The marker which can be moved by the user is defined as the **active marker**.

Examples:



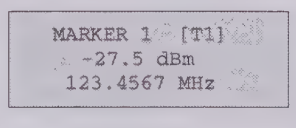
The measurement values of the active marker (also called **marker values**) are displayed in the marker field. In the **marker info list**, the measurement values from all enabled markers are sorted in ascending order. The marker info list can be switched off with the *MARKER INFO* soft key so that only the values for the active marker are shown.

The summary markers have a special function. They read out the rms or average value of the current trace or the trace averaged over several sweeps in the marker info list. These markers are not displayed.

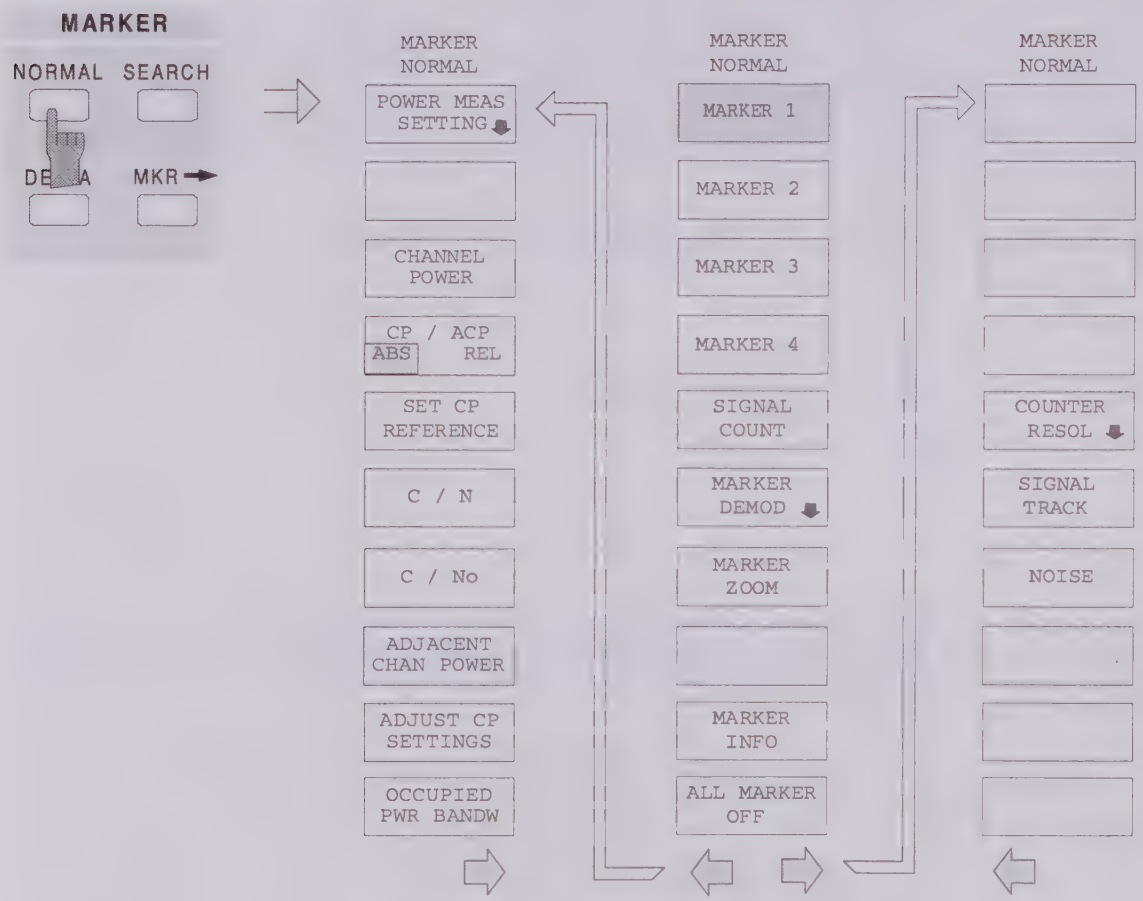
2.9.3.1 Main Markers– *NORMAL Key*

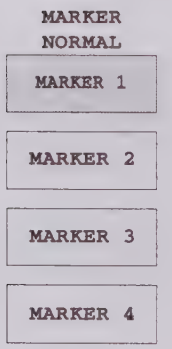
The *NORMAL* key calls a menu which contains all standard functions. The current state of the markers is indicated by a colored illumination of the soft keys. If no marker is enabled prior to pressing the *NORMAL* key, *MARKER 1* will be enabled as the reference marker and a peak search on the measurement curve is carried out (assumption: at least one measurement curve is active). Otherwise, the peak search is omitted and the entry window for the reference marker is activated.

The marker field at the upper left of the display screen shows the marker location (here, frequency), the level and the currently selected measurement curve.



MARKER NORMAL menu:

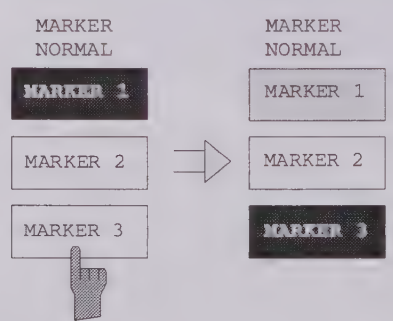




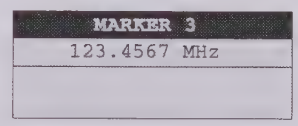
The *MARKER 1* to *MARKER 4* soft keys switch the corresponding marker on/off or activate it as the reference marker. If the marker is activated as a reference marker, an entry field for manually setting the position of the reference marker is opened simultaneously. If the marker is disabled, the soft key is not illuminated. Enabled markers and the reference marker are indicated by illuminating the corresponding soft keys in different colors.(In the instrument default state, the active reference marker is displayed in red and enabled markers are displayed in green.)

Operating example:

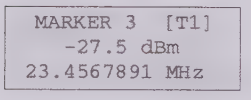
MARKER 1 is shown as the reference marker by the colored background illumination. *MARKER 2* through *MARKER 4* are turned off.

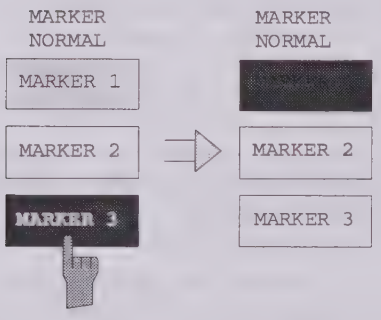


Pressing the *MARKER 3* soft key switches *MARKER 3* on and it becomes the reference maker. The previous reference marker remains enabled and the soft key remains illuminated. However, the entry mode for this marker is not now active. Instead, the entry window for *MARKER 3* is opened and the position of *MARKER 3* can be shifted.



The information in the marker field also changes to describe the new reference marker.





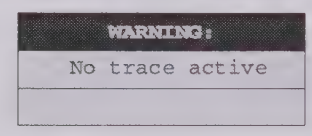
Pressing the current reference marker (*MARKER 3)* soft key again switches *MARKER 3* off. If at least one marker is enabled, the marker with the smallest number will be selected as the new reference marker (in the example, *MARKER 1*). Switching off the last active marker also deletes are delta markers.

When several measurement curves (traces) are being displayed, the marker is set to the maximum value (peak) of the active curve which has the lowest number (1 to 4). In case a marker is already located there, it will be set to the frequency of the next highest level (next peak).

When the split screen display mode is active, the marker will be placed in the active window (for *SCREEN A*: trace 1 or 3, for *SCREEN B*: trace 2 or 4). Since markers are attached to a measurement curve, the marker can only be enabled when at least one curve in the corresponding window is visible .

If a measurement curve is turned off, the corresponding markers and marker functions are also erased. If the curve is switched on again (*VIEW*, *CLR/WRITE*;..), these markers along with coupled functions will be restored to their original positions. A prerequisite for the restoration of the marker positions is that individual markers have not been used on another measurement curve or that the sweep data (start/stop frequency for span > 0 or sweep time for span = 0) have not been changed.

If a marker (or, delta marker) necessary for a marker function is not available, it will be automatically checked whether or not the enabling of the corresponding marker is possible (see above). If this is not the case, a warning is issued.



The activation of the desired marker function is then not possible.

On the other hand, if the marker can be enabled, a peak search is automatically performed. Thereafter, the desired marker function can be executed.

MARKER NORMAL menu:

The *ALL MARKER OFF* soft key switches off all markers (reference and delta markers). Similarly, it switches off all functions and displays correlated with the markers/delta markers (signal count, signal track, marker zoom, N dB down, shape factor, marker list and marker info).

After each sweep, the *SIGNAL TRACK* soft key starts a search for the maximum signal level on the display screen (*PEAK SEARCH)* and then sets the center frequency to this signal (*MARKER ->CENTER)*.

If a threshold line is enabled, only signals above the threshold level are considered. If no signal is over the threshold, the center frequency remains constant until a signal is available which is over the threshold.

If no marker is switched to the active trace, the next unused marker is automatically activated and positioned by the peak search routine.

In order to reduce the search range, it is possible to apply the *SEARCH LIMIT ON/OFF* function (see section: "Search Functions").

The soft key is only available in the frequency domain (spectrum) display mode (span > 0.)

The *MARKER ZOOM* soft key expands the area around the active marker. With the zoom function, more details of the spectrum can be seen. The desired display range can be defined in an entry window.

The following sweep is stopped at the position of the reference marker. The frequency of the signal is counted and the measured frequency becomes the new center frequency. The zoomed display is then configured and the new settings are used by the FSE for further measurements.

As long as switching to the new frequency display range has not yet taken place, pressing the soft key will abort the procedure.

If no marker is activated when the soft key is pressed, then *MARKER 1* is automatically activated and set to the highest peak in the measurement window.

If an instrument setting is changed after selection of *MARKER ZOOM*, the function is aborted.

The *MARKER ZOOM* soft key is only available in the frequency domain (span > 0).

The *MARKER INFO* soft key opens the display of several markers within the grid. In the upper right corner of the grid, a maximum of 4 markers/delta markers with the marker symbols Δ/∇, marker number (1 to 4), position and measurement value are listed. For the output of the marker position, the number or displayed characters will be limited as required.

If the number of lines available is not enough for all the enabled markers and delta markers, first the markers and then the delta markers are entered into the info list

In the *SPLIT SCREEN* display, the info list is partitioned into 2 partial lists and assigned to the corresponding measurement window (*SCREEN A* and *SCREEN B*). The info list for *SCREEN A* contains the markers which are assigned to trace 1 or trace 3. The info list for *SCREEN B* contains the markers which are assigned to trace 2 and trace 4.

For the two measurement windows, it is not possible to turn the *MARKER INFO* function selectively on/off .

2.9.3.1.1 LF Demodulation

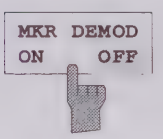
The FSE provides demodulators for AM and FM signals. With these demodulators, a displayed signal can be identified acoustically through the use of the internal loudspeaker or with external headphones. The frequency at which the demodulation is enabled is coupled to the markers. The sweep stops at the frequency determined by the set marker for the selected time and the RF signal is demodulated.

During a measurement in the time domain (span = 0) the demodulation is switched on continuously.

The threshold line performs a squelch function in the demodulator. If the threshold is set, the FSE LF demodulation is switched on only when the signal to be demodulated exceeds the set threshold.

MARKER NORMAL-MARKER DEMOD submenu:

The *MARKER DEMOD* soft key calls a sub-menu in which the type of demodulation desired, the duration of the demodulation and the loudness may be selected

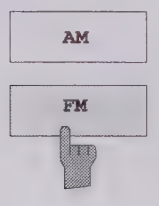


The *MKR DEMOD ON/OFF* soft key switches the demodulation on/off. When the demodulation is on, the sweep is stopped at all marker frequencies, assuming the signal is over the threshold, and the signal is demodulated for the duration of the defined stop time. A total of four stopping points (four markers) can be programmed.

If no marker is set when the demodulation is switched on, the FSE switches the first marker on (*MARKER 1*) and sets it to the largest signal.

The *MKR STOP TIME* soft key activates the entry window for setting the stop time.

The FSE stops the sweep at the marker or the marker for the duration of the defined stop time and then switches the demodulation on (see also *MKR DEMOD ON/OFF*).



The *AM* and *FM* are selection switches of which only one can be activated at any one time. They are used to set the desired demodulation type, FM or AM. The default setting is AM.

The *VOLUME* soft key opens the entry window for setting the loudness. The volume can be set between 0 and 100%.

2.9.3.1.2 Frequency Measurement

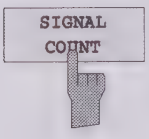
In order to perform an exact determination of the frequency of a signal, the FSE is equipped with an internal frequency counter. The frequency counter measures the frequency of the RF signal at the intermediate frequency. Using the value found at the intermediate frequency, the FSE calculates the frequency of the RF signal by applying the known frequency conversion relationships.

The frequency measurement error depends only upon the accuracy of the frequency standard used (external or internal reference). Although the FSE always operates with a synchronous sweep, independent from the set span, the frequency counter delivers a more exact frequency measurement than a measurement performed with a marker. This is explained by the following:

- The marker measures only the position of the pixel on the measurement curve (trace) and infers therefrom the frequency of the signal. The trace, however, contains only a limited number of pixels. Each pixel, depending upon the selected span, may contain many measurement values which, as a consequence, causes a limitation in the frequency resolution.
- The resolution with which the frequency can be measured is proportional to the measurement time. For measurement time reasons, the bandwidth is normally held as wide as possible and the sweep time is set a short as possible. This results in a loss of frequency resolution.

For the measurement with the frequency counter, the sweep is stopped at the reference marker, the frequency is counted with the desired resolution and then the sweep is allowed to continue (see also Chapter 2, section: "Measurement Examples").

MARKER NORMAL menu:

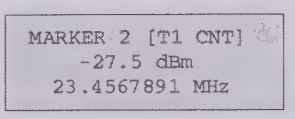


The *SIGNAL COUNT* soft key switches the frequency counter on/off.

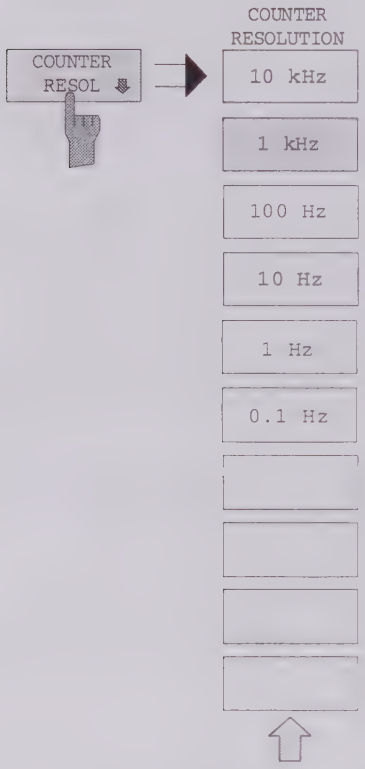
The frequency is counted at the position of the reference marker. The sweep stops at the reference marker until the frequency counter has delivered a result. The time required for a frequency measurement depends on the selected frequency resolution. The resolution is set in the *COUNTER RESOL* sub-menu.

If no marker is enabled when the *SIGNAL COUNT* soft key is pressed, *MARKER 1* is switched on and set at the largest signal.

In addition, the *SIGNAL COUNT* function is displayed in the marker field on the display screen with [T x CNT].



Switching the *SIGNAL COUNT* function off is accomplished by pressing the soft key once again.

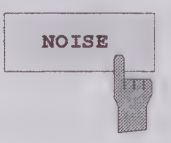


The *COUNTER RESOL* soft key in the right-hand supplementary menu opens a sub-menu in which the resolution of the frequency counter can be defined.
The value can be selected between 0.1 Hz and 10 kHz.

The time which the frequency counter requires for a measurement is proportional to the selected resolution. For example, a 1 Hz resolution will require approximately one second measurement time. In order to prevent slowing the sweep time unnecessarily, it is recommended that the frequency resolution be set as low as possible.

2.9.3.1.3 Noise Power Density Measurement

MARKER NORMAL menu:



The *NOISE* soft key located in the right-hand supplementary menu switches the noise measurement on/off.

During a noise measurement, the noise power density is measured at the position of the reference marker. The display takes place in the marker field dependent upon the vertical units in dBx/Hz (for logarithmic scale) or in V/Hz, A/Hz or W/Hz for linear scales. The correction factors for the selected bandwidth and the conversion of the IF logarithmic converter are automatically taken into consideration.

The measurement should be performed by the sampling detector which allows displaying the effective value of the noise power.

In order to produce a smoother noise display, neighboring points (symmetrical to measurement frequency) on the measurement curve are averaged.

In the time domain display, an average of the measurement values takes place in time (after each sweep).

2.9.3.1.4 Channel Power Measurements

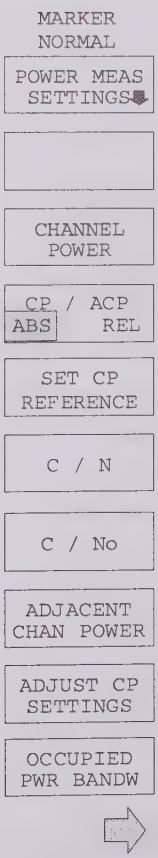
A modulated carrier is almost always used (exception e.g.,.: SSB-AM) for high-frequency transmission of information. As a result carrier modulation with information, the modulated carrier now occupies a frequency spectrum which is defined by the modulation, the transmission data rate and the filtering of the signal. Each carrier is assigned, within a transmission band, to a channel corresponding to these parameters. In order to make error-free transmission possible, each transmitter must adhere to the specified transmission parameters. Among others, these are:

- output power,
- occupied bandwidth, i.e., the bandwidth within which a defined percentage of the power must be contained and
- power output in the neighboring channels.

Using the power measurement function, the FSE is capable of measuring all the specified parameters with high precision and at high speed.

The settings for the power measurements are performed in the left-hand supplementary menu *MARKER NORMAL*.

MARKER NORMAL menu:



The following measurements can be made:

- channel power (*CHANNEL POWER*)
- signal / noise power (*C/N*)
- signal / noise power density (*C/No*)
- adjacent channel power (*ADJACENT CHAN POWER*)
- occupied bandwidth (*OCCUPIED PWR BANDWIDTH*)

The channel power and the adjacent channel power can be measured either relative (*CP/ACP REL*) to the power in the utilised channel or in absolute terms (*CP/ACP ABS*).

Channel configuration is via sub menu *POWER MEAS SETTINGS*.

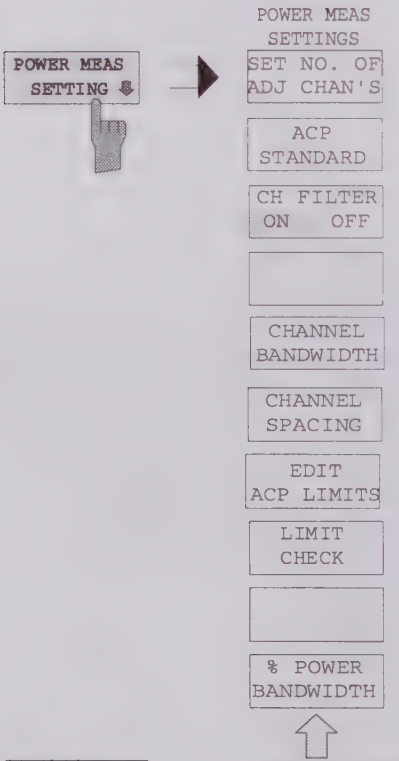
The above mentioned power measurements can be carried out alternately.

2.9.3.1.4.1 Channel Configuration

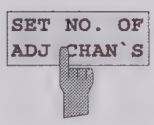
For all power measurements, a specified channel configuration is assumed which is, e.g. oriented on a specific radio communications system.
The channel configuration is defined by the nominal channel frequency (= center frequency of the FSE), the channel bandwidth (*CHANNEL BANDWIDTH*) and the channel spacing (*CHANNEL SPACING*).
The channel is indicated on the display screen by vertical lines located at a half-channel bandwidth to the left and to the right of the channel frequency.
For the adjacent channel power measurement, the adjacent channels are also indicated by vertical lines. The lines of the utilised channel are labelled with CO for easier recognition.
Depending on the radio communication service, the power of the 1st alternate channel and/or 2nd alternate channel can be measured in addition (soft key *SET NO.OF ADJ CHAN'S*).

With the *ACP STANDARD* soft key, the channel configuration can be set automatically according to the regulations of different digital mobile-radio standards.
For some standards, the channel power has to be evaluated by means of a root-cosine filter corresponding to the transmit filter. This filter is switched on automatically if the corresponding standards are selected but can be switched off manually (soft key *CH FILTER ON/OFF).*

MARKER NORMAL - POWER MEAS SETTINGS submenu:



The *POWER MEAS SETTINGS* soft key calls the sub-menu for the definition of the channel configuration.



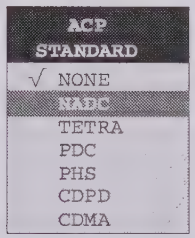
The *SET NO. OF ADJ CHAN'S* soft key activates the input of number ±n adjacent channels to be considered for adjacent channel power measurement.

The individual powers are indicated separately. Example n=3:

```
CH0 Pwr   -20.00 dBm
ACP UP    -45.23 dBm
ACP LOW   -52.11 dBm
ALT1 UP   -60.04 dBm
ALT1 LOW  -61.00 dBm
ALT2 UP   -63.34 dBm
ALT2 LOW  -64.00 dBm
```

1, 2 or 3 adjacent channels are possible. ALT1 and ALT2 (Alternate Channel Power) indicate the channel power at ± 2 × channel spacing and ± 3 × channel spacing from the center of the channel.

The *ACP STANDARD* soft key activates the selection of a digital mobile-radio standard. The parameters for the adjacent channel power measurement are set according to the regulations of the selected standard.



The following standards can be selected:

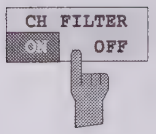
NADC (IS-54 B)
TETRA
PDC (RCR STD-27)
PHS (RCR STD-28)
CDPD
CDMA

The selection of a standard influences the following parameters:

- channel spacing
- channel bandwidth
- modulation filter
- resolution bandwidth
- video bandwidth
- detector

Trace Maths and Trace Averaging are switched off.
The reference level is not influenced by automatic matching. It has to be set for an optimum dynamic range so that the signal maximum is in the vicinity of the reference level.

The basic setting *ACP STANDARD NONE*.



The *CH FILTER ON/OFF* soft key switches a modulation filter for the channel power and adjacent channel power measurement on or off.

When selecting the digital mobile-radio standards NADC and TETRA using the *ADC STANDARD* soft key, the soft key is automatically set to ON. When the other standards are selected, weighting is not selectable and the soft key is not available.

CH FILTER ON — The channel bandwidth is defined by the filter weighting alone. Therefore, the *CHANNEL BANDWIDTH* soft key cannot be operated.

The activated modulation filter influences the channel and adjacent channel power measurement.

Within the definition range of the filter, the individual pixels are weighted with the calculated filter attenuation as a function of the spacing to the channel center. The weighted display points are then added to the total channel power.

CH FILTER OFF — No modulation filter is switched on.

The *CHANNEL BANDWIDTH* soft key opens an entry window for setting the channel bandwidth for the transmission channel and the corresponding adjacent channels.

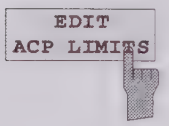
For all channels, the default setting is 14 kHz.

ACP CHANNEL BW	
CHAN	BANDWIDTH
CH	14 kHz
ADJ	14 kHz
ALT1	14 kHz
ALT2	14 kHz

Note: *If the bandwidth of one channel is changed, the new value is also assigned to all subsequent channels in the table. The bandwidths for the individual channels can be set independently, however, by overwriting the table from the top to the bottom.*

The *CHANNEL SPACING* soft key opens an entry window for defining the channel spacing. The channel spacing is the separation between the center frequencies of adjacent channels.

The default setting for channel spacing is 20 kHz.

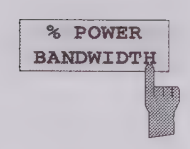


The *EDIT ACP LIMITS* opens a table for defining the limits for ACP-measurement.

ACP LIMITS			
CHAN	CHECK	LOWER CHANNEL LIMIT	UPPER CHANNEL LIMIT
ADJ	√	-50 dB	-50 dB
ALT1	√	-60 dB	-60 dB
ALT2			

The limit values are defined either in units of dB (for*CP/ACP REL*) or in dBm (for *CP/ACP ABS*).

Note: *Measured values that exceed one of the limits are marked with an preceding asterisk.*



The *% POWER BANDWIDTH* soft key opens an entry window for defining the percentage of the power with respect to the total power in the displayed frequency range. This defines the occupied bandwidth (percent of the total power).

The permitted range is 10 % - 99,9 %.

2.9.3.1.4.2 Channel Power Measurement

The *CHANNEL POWER* measurement is performed by an integration of the measurement points within the channel bandwidth. The channel is marked by two vertical lines to the left and to the right of the center frequency as defined by the channel bandwidth (see Fig. 2.9-1).

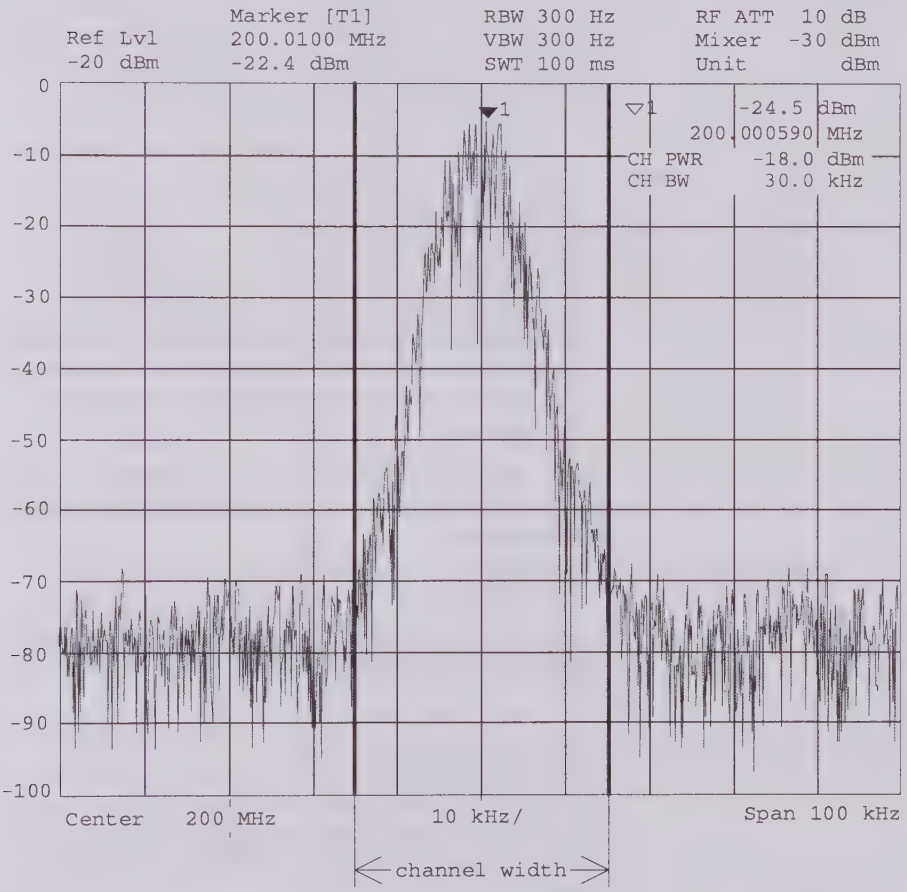
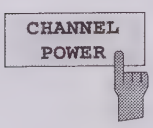


Fig. 2.9-1 Determination of the channel width.

MARKER NORMAL menu:



The *CHANNEL POWER* soft key initiates the calculation of the power in the measurement channel. The display takes place in the units of the y axis, e.g., in dBm, dBV.

The calculation is performed by summing the power at the pixels within the specified channel.

The measurement is either absolute or relative to a reference power (see the *CP/ACP ABS/ REL* soft key).

The *CP/ACP ABS/REL* soft key (Channel Power/Adjacent Channel Power Absolute /Relative) switches between an absolute and relative display of the power measured in the channel or adjacent channel.

Channel power measurement

CP ABS — The absolute value of the power is displayed in the unit of the Y axis, eg in dBm, dBV.

CP REL — The power of a freely selected channel is measured. This power is set in relation to the power of a reference channel. The reference channel power is selected beforehand using the *SET CP REFERENCE* soft key, ie:

1. Declare the power in the currently measured channel as the reference value using the *SET CP REFERENCE* soft key.
2. Set the channel of interest by changing the channel frequency (FSE center frequency).

   In case of linear scale of the Y axis the relative power (CP/CP_{ref}) of the new channel is displayed in addition to the reference channel. In case of dB scale, the logarithmic ratio $20 \times \log (CP/CP_{ref})$ is displayed.

Thus, the relative channel power measurement can also be used for universal adjacent channel power measurements.

Example:
Measurement of the 1597-QCDMA adjacent channel power. The useful channel and the adjacent channels have different bandwidths (1.23 MHz or 30 kHz).

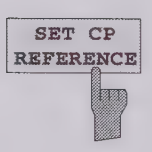
Adjacent channel power measurement

The power of the adjacent channels is measured. The reference value is the power of the useful channels (see measurement of the adjacent channel power). The useful channel is marked by two vertical lines that are labelled with C0.

ACP ABS — The powers of the useful channel and of the adjacent channels are displayed as absolute values in the unit of the Y axis.

ACP REL — The logarithmic ratio $20 \times \log (CP/CP_0)$ of the powers of the adjacent channels to the useful channel is displayed.

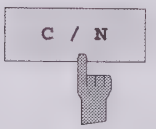
The soft key is not available for *OCCUPIED PWR BANDWIDTH*, *C/N* and *C/N0*



For an activated *CHANNEL POWER* power measurement, the *SET CP REFERENCE* soft key sets the reference value to the currently measured channel power.

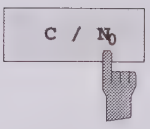
2.9.3.1.4.3 Signal / Noise Power Measurement

MARKER NORMAL menu:



The *C/N* (Carrier to Noise) soft key calculates the ratio of carrier power to noise power and the power of interference signals in the channel defined under *POWER MEAS SETTING*. For the measurement, a marker must be set to the carrier of interest.

The unit of C/N is dB when the display is logarithmic. When the display is linear, C/N is shown without a unit.



The C/N_0 soft key starts the C/N_0 measurement.
In contrast to the *C/N* measurement, C/N_0 calculates the ratio of carrier power to noise and interference signals based on a 1 Hz bandwidth in the channel defined under *POWER MEAS SETTING*.

The unit of C/No is dB/Hz when the display is logarithmic and 1/Hz when the display is linear.

Measurement procedure:

1. Activate a marker and position it to the peak of the carrier signal (e.g., with the *Marker -> Peak* soft key).
2. Select With the desired frequency range (channel) with the *FREQUENCY CENTER* and *CHANNEL BANDWIDTH* (*POWER MEAS SETTING* sub-menu) soft keys.
3. Press the *C/N* or C/N_0 soft key. The marker is set to reference fixed and activates each measurement. It must be observed that the carrier is either located outside of the measurement channel or turned off at the UUT (Unit Under Test).
4. Press the ADJUST CP SETTINGS soft key to active the default settings with modified channel parameters.

The measurement values for C/N or C/N_0 are displayed in the marker info field.

Notes: – *If no carrier marker was set, only N or N_0 with the appropriate units is displayed.*
– *Is the carrier located inside the measurement channel, C/C+N or $C/C+N_0$ will be displayed*

Example:

The signal-to-noise ratio of the carrier (f = 199.9 MHz) in the channel with +100 kHz separation from 200 MHz (channel center frequency) is to be measured. The channel bandwidth is 150 kHz.

1. Using the *CENTER* key, set the center frequency to the channel center frequency 200 MHz.
2. Using the *SPAN* key, set the span, e.g., to 1 MHz (carrier must be visible).
3. Using the *MARKER NORMAL* key, activate *MARKER 1* (If Marker 1 was not yet active, the function *MARKER→ PEAK* is automatically executed. In this case, skip step 4.)
4. Using the *MARKER→ PEAK* key, set *MARKER 1* on the carrier (assumption: the 200 MHz carrier has the highest level in the selected span).
5. Press the *MARKER NORMAL* key and change to the left-hand supplementary menu.

6. Using the *POWER MEAS SETTING* soft key, call the sub-menu for defining the measurement channel.
7. Using the *CHANNEL BANDWIDTH*: soft key, set the bandwidth to 150 kHz (The channel spacing does not need to be entered for this measurement). Then press ⇑ menu change key.
8. Using the *C/N* soft key, start the C/N measurement. In the marker info field, the outputs *CHANNEL CENTER, CHANNEL BANDWIDTH* as well as the corresponding C/N measurement values appear. *MARKER 1* is also set to reference fixed.
9. Using the *ADJUST CP SETTINGS* soft key, activate the default settings with modified channel parameters (channel bandwidth = 150kHz) for the correct C/N measurement (span = 2 × channel bandwidth = 300 kHz, RBW = 3 kHz, VBW = 10 kHz, detector: sampling).

Two vertical lines mark the channel 200 MHz ± 75 kHz in which the noise measurement is performed (see Fig. 2.9-2). The reference value is the measurement from *MARKER 1* (Reference Fixed).

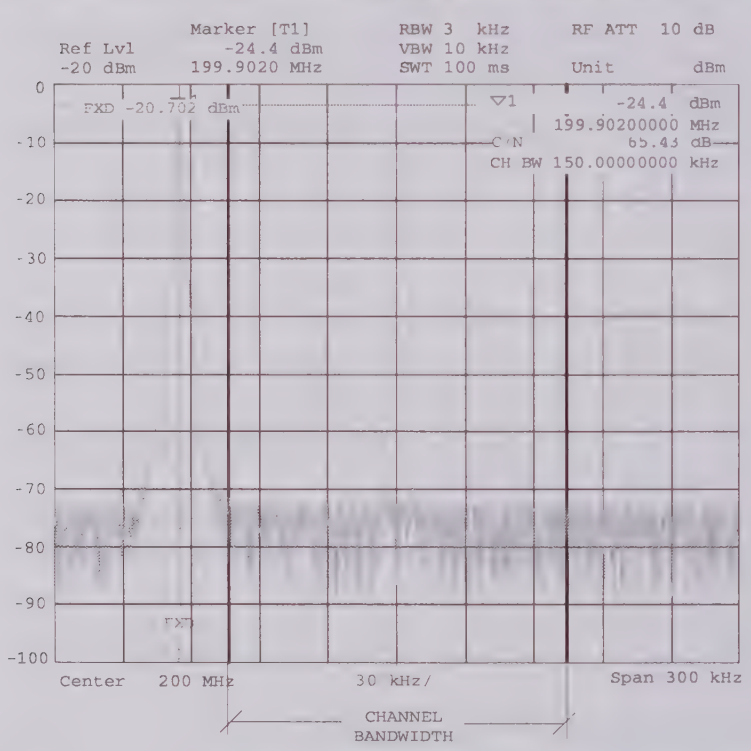
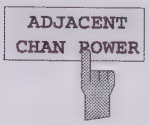


Fig.2.9-2 Example: measurement of the signal/noise power.

2.9.3.1.4.4 Adjacent Channel Power

MARKER NORMAL menu:



The *ADJACENT CHAN POWER* soft key starts the measurement of the adjacent channel power.
The *ADJACENT CHAN POWER* measures the power which the transmitter delivers to the two adjacent channels (upper channel , lower channel). The measurement values are displayed according to the setting of the *CH/ACD ABS/REL* soft key as absolute values in the scale of the X axis (see Fig.) or as a logarithmic ratio of adjacent channel to useful channel in dB (20 × log (CP/CP_0).

If the power of the other neighbouring channels is to be measured in addition to the adjacent channel power, the number of adjacent channels can be extended (on one side only) using *SET NO. OF ADJ CHAN'S* in the submenu *POWER MEAS SETTINGS*.

A prerequisite for the correct measurement of the adjacent channel power is the correct setting of the FSE center frequency, the channel bandwidth and the channel spacing.
The *CHANNEL SPACING* and *CHANNEL BANDWIDTH* are defined in the *POWER MEAS SETTINGS* sub-menu.
For an activated measurement of adjacent channel power, the analyzer itself optimally sets all other values (span, resolution bandwidth, detector, etc.) after the *ADJUST CP SETTINGS* soft key is pressed. The carrier power in the utilised channel, the power (absolute or relative to the utilised channel) in the upper and lower adjacent channels as well as the largest of the two power values and the channel raster with channel spacing and bandwidth are displayed as the result of the measurement. The C0 lines mark the bandwidth of the carrier channel. Other unlabelled frequency lines mark the adjacent channels (see Fig. 2.9-3). With *SET NO. OF ADJ CHAN'S 2* selected, the other two neighbouring channels (1st Alternate Channels) are displayed as well, with *SET NO. OF ADJ CHAN'S 3* selected, an additional channel each (2nd Alternate Channels).
The measurement values are updated and displayed until the *ADJACENT CHAN POWER* soft key is pressed again and the measurement of the adjacent channel power is stopped.

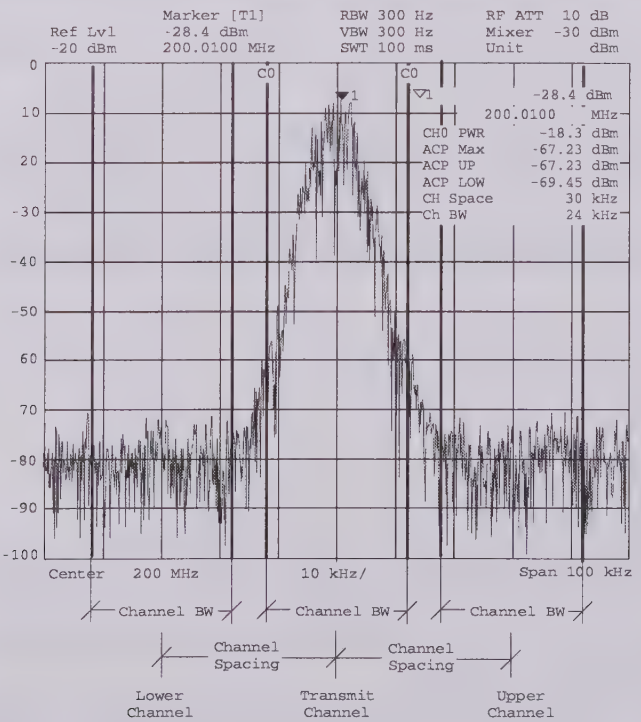


Fig.2.9-3 Measurement of the adjacent channel power.

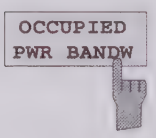
If the limit check is activated for ACP measurements, the result of the limit check (PASSED/FAILED) is displayed as well as an asterisk preceding each measured ACP power that exceeded one of the limits.

Note: *The limit check is activated and the limits are defined in the POWER MEAS SETTINGS menu.*

2.9.3.1.4.5 Occupied Bandwidth Measurement

An important characteristic of a modulated signal is the bandwidth which it occupies. The occupied bandwidth must be limited in a radio communications system so that disturbance-free transmission in adjacent channels is possible. The occupied bandwidth is defined as the bandwidth in which a defined percentage of the total transmitter power is contained. The percentage of the power can be set between 10 and 99% in the FSE.

MARKER NORMAL menu:



The *OCCUPIED PWR BANDW* (occupied power bandwidth) soft key starts the measurement for determining the occupied bandwidth.
In the spectrum display mode, the bandwidth is determined in which a predefined percentage of the power in the displayed bandwidth is contained. (selectable in the *POWER MEAS SETTINGS* sub-menu with the : *% POWER BANDWIDTH* soft key). The occupied bandwidth is output to the marker display field and marked on the measurement curve with temporary markers.

Measurement principle:

For example, the bandwidth is to be found in which 99% of the signal power is contained. The routine calculates first the total power of all displayed points (pixels) of the measurement curve. In the next step, the measurement points from the right edge of the measurement curve are integrated until 0.5% of the total power is reached. Then the FSE integrates, in an analog fashion, from the left edge of the measurement curve until 0.5% of the power is reached. The delta marker is positioned at this point. Thus, 99% of the power is located between the two markers. The difference between the two frequency markers is the occupied bandwidth which is displayed in the marker info field.

A prerequisite for the correct operation of the measurement is that **only** the signal to be measured is visible on the display screen of the FSE. An additional signal would falsify the measurement.

In order to be able to perform correct power measurements, especially for noisy signals, and thus to achieve the correct occupied bandwidth, the selection of the following parameters should be observed:

RBW	<< occupied bandwidth (≤ approx. 1/20 of the occupied bandwidth, for voice communications, typ. 300 Hz or 1 kHz)
VBW	≥ 3 x RBW
detector	sampling
span	≥ 2 to 3 x occupied bandwidth

According to the application or other measurement guidelines, it may be necessary or reasonable to average a definite number of sweeps in order to achieve a usable value for the occupied bandwidth.

This is provided by the *TRACE* (1....4) key group and the averaging function. With the *SWEEP COUNT* soft key, the number of averages is defined.
Some measurement instructions (e.g. PDC, RCR, STD-27B) require the occupied bandwidth to be measured by means of a peak detector. In this case, the detector of the FSE must be corrected appropriately.

2.9.3.1.4.6 Parameters for Channel Power Measurements / Configuration

For the correct measurement of channel power, C/N, C/N0, adjacent channel power and occupied bandwidth, it is recommended that an automatic optimisation of the analyzer settings be performed after enabling the corresponding measurement and selecting the channel configuration (channel power settings).

MARKER NORMAL menu:

The *ADJUST CP SETTINGS* soft key optimises automatically the settings of the analyzer for the selected power measurement (see below).

Thus, all relevant analyzer settings for a power measurement within a defined frequency range (channel bandwidth) are optimally set including:

- span
- resolution bandwidth
- video bandwidth
- detector

dependent upon the channel configuration (channel bandwidth and, if needed, channel spacing).

The trace mathematical functions and trace averaging are switched off.

The reference level is not influenced by the automatic optimisation routine. The reference level is to be so adjusted that the signal maximum is located near the reference level.

The optimisation is performed only once, however, if necessary, the instrument settings may be changed later.

Span

The span should cover at least the frequency range that is to be observed. For measurements of channel power, C/N and C/N0, this is the channel bandwidth. For adjacent channel power measurements, this is the utilised channel bandwidth and the adjacent channels located within the channel spacing.
If the span is large compared to the observed frequency band(s), then only a few points on the measurement curve are available for the measurement.

The *ADJUST CP SETTINGS* soft key sets the span as follows:

2 × channel bandwidth	for channel power, C/N, C/No
	or
2 × channel spacing + channel width	for adjacent channel power
4 × channel bandwidth	for adjacent channel power and NO. OF ADJ CHAN`S 2
6 × channel spacing + channel width	for adjacent channel power and NO. OF ADJ CHAN`S 3

For measurements of the occupied bandwidth, the span is not influenced.

Resolution bandwidth (RBW)

In order to achieve acceptable speed as well as the necessary selection (to suppress spectral components outside of the frequency range to be measured and, especially the adjacent channels), the resolution bandwidth should not be chosen too broad or too narrow.
If the resolution bandwidth is too narrow, the measurement speed becomes very slow and it is possible that relative spectral components are not displayed (due to the sampling detector necessary for power measurements and the finite number of points).
On the other hand, the resolution bandwidth should not be so broad that, due to insufficient selection, spectral components outside of the observed frequency range (from adjacent channel) falsify the measurement results.

The *ADJUST CP SETTINGS* soft key sets the resolution bandwidth (RBW) dependent upon the channel bandwidth as follows:

RBW ≤ 1/40 of the channel bandwidth. The largest possible RBW, with due regard to the 1, 2, 3, 5 step size and the requirement RBW ≤ 1/40 will be selected.

The RBW is not influenced by measurements of the occupied bandwidth.

Video bandwidth (VBW)

Since a power measurement of the noise components is also necessary (otherwise, errors occur due to the logarithmic characteristics of the spectrum analyzer), the video bandwidth should be chosen substantially larger than the resolution bandwidth.

The *ADJUST CP SETTINGS* soft key adjusts the video bandwidth (VBW) dependent upon the channel bandwidth as follows:

VBW ≥ 3* RBW. The smallest VWB with regard to the available 1, 2, 3, 5 step size is selected.

Grid scale

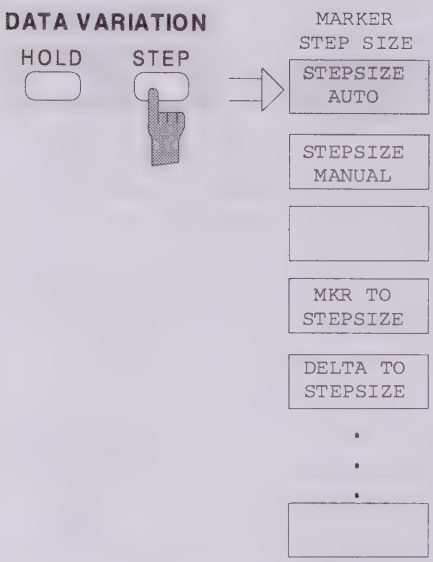
The *ADJUST CP SETTINGS* soft key sets the grid scale to the 100-dB range. Thereby, a wide dynamic range in channel power measurements is achieved.

Detector

The *ADJUST CP SETTINGS* soft key selects the sampling detector.
The sampling detector is to be selected, above all, for correct power measurements of noisy signals within the observed frequency range.

2.9.3.1.5 Marker Step Size

DATA VARIATION – STEP menu:



The *STEP* key in the *DATA VARIATION* key group opens a menu to match the marker step size to each individual application. In order to change the step size, the marker entry mode must already be active.

Control is returned to the *MARKER NORMAL* menu via the menu key.

The *STEPSIZE AUTO* soft key sets the marker step size to *AUTO*. In this case, the step size is exactly 10% of the grid. A one-raster movement of the roll-key corresponds to one pixel.

STEPSIZE AUTO is the default setting.

The *STEPSIZE MANUAL* soft key activates the entry window for defining a fixed value for the marker step size.

Pressing the step key shifts the marker position by the selected step size. The resolution of the roll-key is always one pixel per raster.

The *MKR TO STEPSIZE* or *DELTA TO STEPSIZE* soft keys sets the marker step size to the current (delta) marker frequency or (delta) marker time, respectively.

In the frequency domain, this function is well suited to harmonic measurements. The marker is set to the largest signal using the peak search function. After activation of the *MKR TO STEPSIZE* function, the marker is set to the corresponding harmonic of the signal each time the cursor key or is pressed when entering the marker position (see also Chapter 2, section "Measurement Examples").

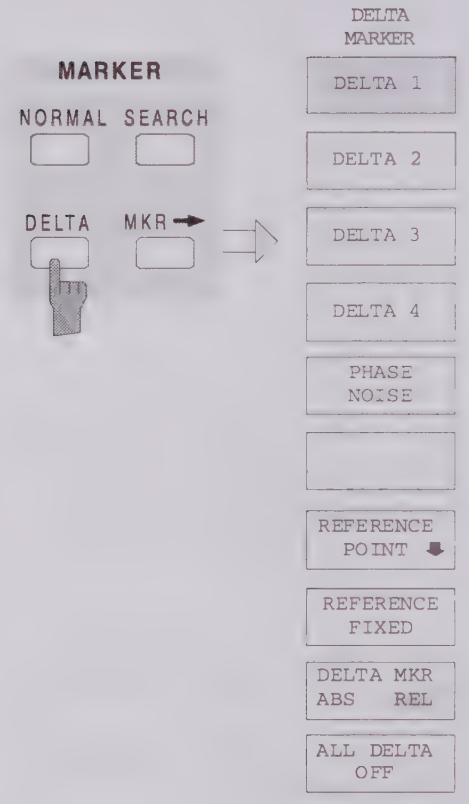
The *DELTA STEPSIZE* soft key sets the marker step size to the difference between the reference marker and the last active delta marker.

The soft key is only available when at least one delta marker is enabled.

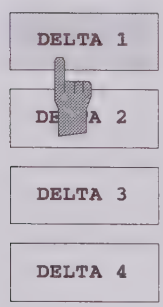
2.9.3.2 Delta Markers – *DELTA Key*

The delta markers are used to measure a level or frequency referred to a reference marker. They are always referenced to the marker whose position was last changed. A delta marker is displayed as an empty △ symbol. The reference marker is displayed as a filled ▼ symbol.

MARKER DELTA menu:



The *DELTA* key switches a delta marker on and calls the menu for its control. If no marker is enabled, *MARKER 1* is automatically activated when the delta marker is switched on. The delta marker activated to entry mode is shown on the display screen as a filled ▲ symbol.



The *DELTA 1 to 4* soft keys are used to enable delta markers 1...4. The control of the delta markers corresponds to that of the markers. After a delta marker has been enabled, all entries are now applicable to this marker. The main marker must be activated anew if its position is to be changed.

The delta marker field on the display screen contains the delta marker number, the difference frequency from the delta marker to reference marker and the level difference between the active delta markers and reference markers.

The indicated differences are, in general, referred to the reference marker. If the *PHASE NOISE* or *REFERENCE FIXED* functions are enabled, the reference values under *REFERENCE POINT* are applicable.

The *DELTA ABS REL* soft key switches between relative and absolute entry modes for the delta-marker frequency.

In the *REL* position, the delta marker frequency is entered relative to the reference marker. In this case, the entry mode for the delta-marker frequencies is also relative.

In the *ABS* position, the entry of the delta-marker frequency is in terms of absolute frequency.

The default setting is *REL*.

The *ALL DELTA OFF* soft key switches off all active delta markers and any associated functions (e.g. *REFERENCE FIXED*, *PHASE NOISE*).

The *REFERENCE FIXED* soft key enables/disables relative measurements with respect to a fixed, measurement-curve-independent reference value.

The information in the delta-marker field on the display screen is referenced to this fixed reference value. For the generation of the marker lists using *MARKER INFO* list, the delta markers are also output relative to a fixed reference. In the lists, the *REFERENCE POINT* is tagged by the number of the reference marker (only one enabled)

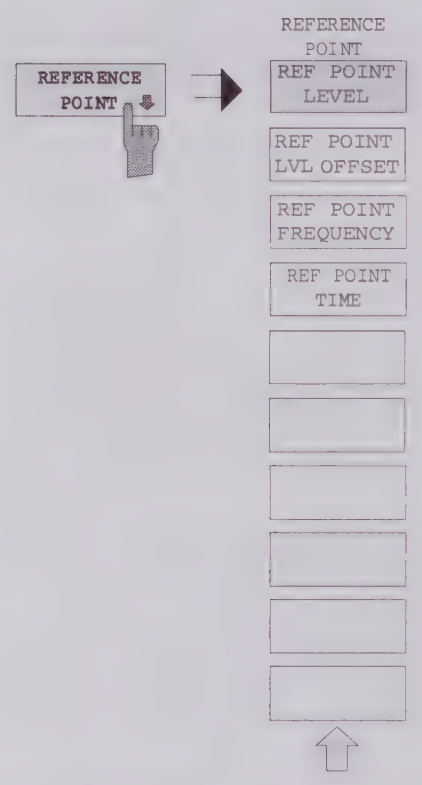
When *REFERENCE FIXED* is enabled, the current settings of the reference marker become the reference values. If no marker is active, *MARKER 1* (with peak search) is activated. After transferring the reference values, all markers are deleted, and the active delta marker is set to the position of the reference value. Additional delta markers can be switched on.

The reference value can be subsequently changed

1. by shifting it in the *REFERENCE POINT* sub-menu.
2. by starting a search:
   In the *MARKER NORMAL* menu the *REF POINT* is handled as a reference marker (even though it is not bound to the measurement curve). This means, that it will be shown as enabled and can also be changed in position. The co-ordinates of the *REF POINT* are overwritten by the marker values (they lie, by definition, on the measurement curve). Thus, it is possible, even for an enabled *REFERENCE FIXED*, to define a new reference point function with search functions.

The *REFERENCE FIXED* function is particularly useful for measurements which are performed relative to a reference signal that is not available during the whole measurement time (e. g. harmonics measurements, see section 2.1.2.4).

MARKER DELTA- REFERENCE POINT submenu:



The *REFERENCE POINT* soft key opens a sub-menu in which the reference value the *REFERENCE FIXED* and *PHASE NOISE* functions can be modified.

The position of the reference value is indicated by two additional display lines (horizontal and vertical). In addition, an offset level may be defined which is added to each difference during output.

The soft key is only available when the *REFERENCE FIXED* or *PHASE NOISE* function is switched on.

The *REF POINT LEVEL* soft key activates an entry box for setting the reference level relevant to the *REFERENCE FIXED* or *PHASE NOISE.* functions.

The *REF POINT FREQUENCY* soft key activates the entry box for the input of a reference frequency for the *REFERENCE FIXED* or *PHASE NOISE.* functions.

The *REF POINT LVL OFFSET* soft key activates the entry box for the entry of an additional offset level during output when the *REFERENCE FIXED* or *PHASE NOISE.* functions are enabled.

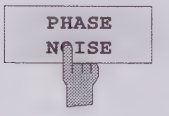
The offset level is set to 0 dB when the *REFERENCE FIXED* or *PHASE NOISE.* functions are switched on.

The *REF POINT TIME* soft key activates the entry box for the input of a reference time for the *REFERENCE FIXED* function in the time domain (span = 0).

The entry of a reference time for the *PHASE NOISE* function is not possible.

2.9.3.2.1 Phase Noise Measurement

MARKER DELTA menu:



The *PHASE NOISE* soft key switches the *PHASE NOISE* function on/off.

Enabling the *PHASE NOISE* function causes the frequency and level of the reference marker to be transferred as reference values, that means, the REFERENCE FIXED function is activated.

The difference between this reference point and the active delta markers is determined. The correction factors for bandwidth and the logarithmic converter are automatically taken into consideration. The sampling detector is also enabled to allow the effective noise power to be displayed. The measured values are displayed in the delta marker field in units of dBc/Hz.

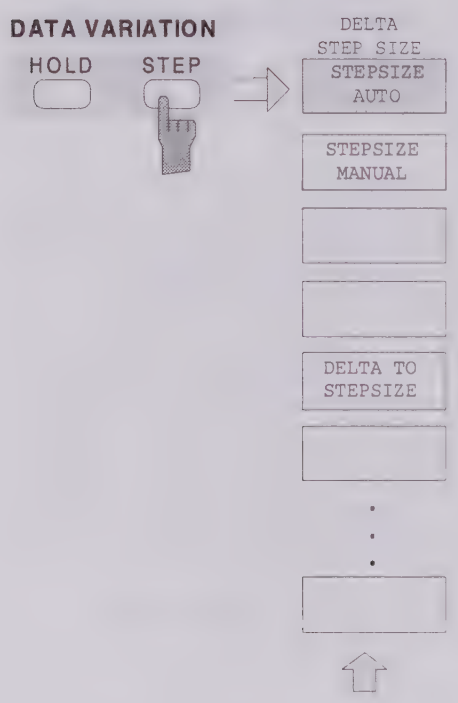
If several delta markers are enabled, only the measurement value output of the active marker is shown in the marker field. Using *MARKER INFO* and *MARKER LIST* the measurement data of all delta markers can be displayed.

If no marker is present when the *PHASE NOISE* function is enabled, *MARKER* 1 is automatically switched on (peak search), and the marker values are saved as reference values. The reference value can be changed later in the *NORMAL* menu, *SEARCH* menu or *REFERENCE POINT* sub-menu (see *REFERENCE FIXED* soft key).

Turning on an additional marker causes the *PHASE NOISE* function to be disabled.

2.9.3.2.2 Delta-Marker Step Size - *STEP Key*

STEP-DELTA STEP menu:



The *STEP* key in the *DATA VARIATION* key group opens a menu to match the step size of the individual delta markers to the specific application. In order to change the step size, the entry mode for a delta marker must already be active.

Control is returned to the DELTA MARKER menu via the menu key.

The *STEPSIZE AUTO* soft key sets the delta marker step size to *AUTO*. In this case, the step size of the delta marker is exactly 10% of the grid. The roll-key corresponds to 1/500, i.e., for each rotational pulse, the delta marker is shifted one pixel position.

The *STEPSIZE MANUAL* soft key permits the entry of a fixed value for the delta marker step size.

Pressing the step-key shifts the marker position by the selected step size. The roll-key resolution, however, always remains constant at 1 pixel.

The *DELTATO STEPSIZE* soft key sets the delta marker step size to a quantity equal to the difference between the delta and reference markers.

The soft key is only presented when at least one delta marker is switched on.

2.9.3.3 Search Functions – SEARCH Key

The FSE offers numerous functions useful for peak/min. peak searching. The search functions can be used for marker as well as delta marker functions.

The setups applicable to the available search functions are performed in the *MARKER-SEARCH* menu.

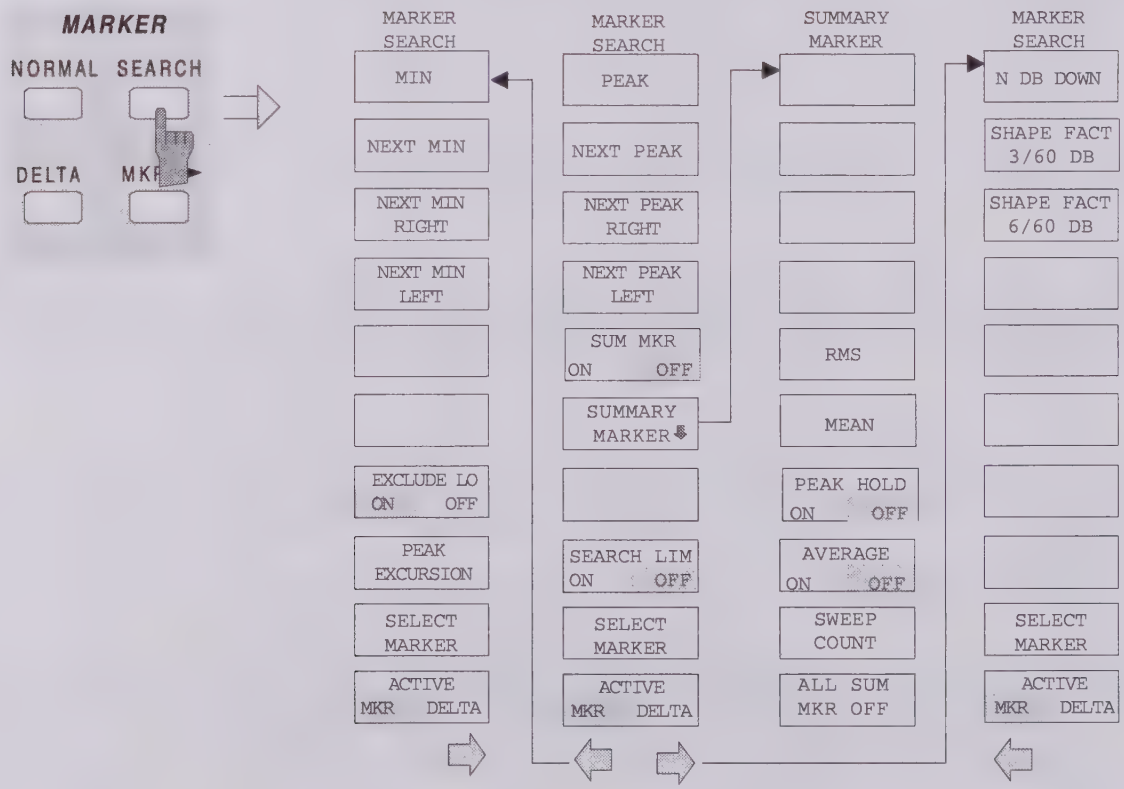
The search functions are always related to the currently active marker. If the *SEARCH* key is pressed while the marker entry mode is active, then all search functions are related to the current reference marker. If the entry mode of a delta marker is active, then the functions will be applied to the corresponding delta marker. For the case where no marker is active, *MARKER* 1 will be automatically enabled (with peak search). The *ACTIVE MKR / DELTA* soft key allows toggling between the active marker and the active delta marker.

If the threshold line is turned on, the peak/min. search functions will only evaluate signals which have a level above/below the selected threshold. In addition, the search range can also be limited (*SEARCH LIM ON/OFF* soft key) by the frequency/time lines (*FREQUENCY LINE 1/2, TIME LINE 1/2*).

For all peak search functions, the first local oscillator is omitted at 0 Hz if it happens to be displayed.

In the time domain display, the summary markers can be activated and set in addition to the search functions in menu *MARKER-SEARCH*.

MARKER SEARCH menu:



The *ACTIVE MKR / DELTA* soft key toggles between the active marker and the active delta marker.

If *DELTA* is illuminated, the following search functions are performed with the active delta marker.

Note: *Switching between marker and delta marker entry modes may also be performed using the NORMAL and DELTA keys.*

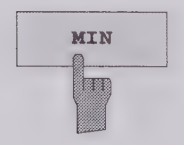
The *SELECT MARKER* soft key activates the selection of the marker/delta markers. The selection box lists the currently enabled markers/delta markers.

The *PEAK* soft key sets the active marker/delta marker to the maximum displayed value on the corresponding trace.

The *NEXT PEAK* soft key sets the active marker/delta marker to the next lower peak value on the corresponding curve.

The *NEXT PEAK RIGHT* soft key sets the active marker to the next peak to the right of the current marker position.

The *NEXT PEAK LEFT* soft key sets the active marker to the next peak to the left of the current marker position.

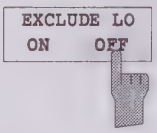


The *MIN* soft key sets the active marker to the lowest displayed peak on the corresponding measurement curve.

The *NEXT MIN* soft key sets the active marker to the next higher of the low peaks on the corresponding measurement curve.

The *NEXT MIN RIGHT* soft key set the active marker to the next low peak to the right of the current marker position.

The *NEXT MIN LEFT* soft key sets the active marker to the next low peak to the left of the current marker position.



The *EXCLUDE LO ON/OFF* softkey switches between a restriced (*ON*) and an unrestricted search range (*OFF*).

ON Because of non-ideal input mixer, the first LO of any analyzer can be seen at 0 Hz. The search functions can possibly respond to this LO level, in particular in the preset setting (FULL SPAN). To avoid this, the search range is restricted according to the following formula:

$$\text{Search range} \geq 6 \times \text{resolution bandwidth}$$

OFF No restriction to the search range. The search functions find also signals below the frequency limit quoted above.

The *PEAK EXCURSION* soft key activates the entry box which sets the minimum amount a signal level must decrease/increase before it is recognised by the search functions (except PEAK and MIN) as a maximum or minimum.

Input values from 0 dB to 80 dB are allowed with a resolution of 0.1 dB.

The peak excursion is preset to 6 dB. This is completely sufficient for the functions *NEXT PEAK* (or *NEXT MIN*) as always the next smaller (or higher) signal is searched four.

Functions *NEXT PEAK LEFT* and *NEXT PEAK RIGHT* (or *NEXT MIN LEFT and NEXT MIN RIGHT*) search for the next relative maximum (or minimum) independent of the current signal amplitude.
As for wide bandwidths, the set 6-dB level change is already reached by the noise indication of the analyzer, the noise values are also identified as peak. In this case, *PEAK EXCURSION* has to be selected with a higher value than the difference between the highest and lowest noise indication values.

The following example shows the effect of different *PEAK EXCURSION* settings.

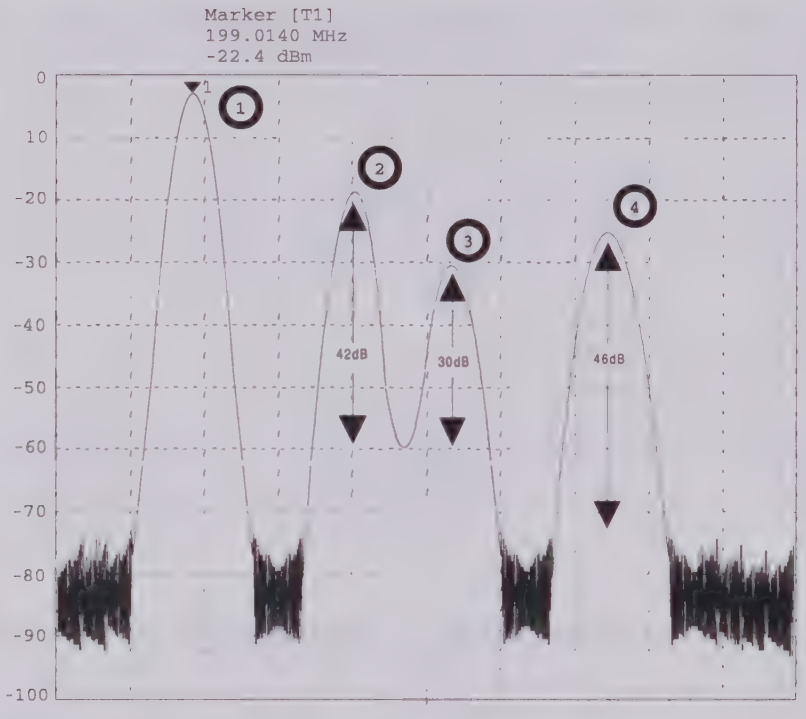


Fig. 2.9-4 Example for level measurements at different peak excursion settings

Maximum relative level change of the measured signals:

Signal 2:	42dB
Signal 3	30dB
Signal 4:	46dB

Setting **Peak Excursion 40dB** causes signal 2 and 4 to be detected with *NEXT PEAK* or *NEXT PEAK RIGHT*. Signal 3 is not detected since it is only decreased by 30 dB before the level rises again.

Order of signals found:

PEAK:	Signal 1
NEXT PEAK:	Signal 2
NEXT PEAK:	Signal 4

or

PEAK:	Signal 1
NEXT PEAK RIGHT:	Signal 2
NEXT PEAK RIGHT:	Signal 4

Setting **Peak Excursion 20dB** causes signal 3 to be detected since its highest level change of 30 dB is now higher than the set peak excursion.

Order of signals found:

PEAK:	Signal 1
NEXT PEAK:	Signal 2
NEXT PEAK:	Signal 4
NEXT PEAK:	Signal 3

or

PEAK:	Signal 1
NEXT PEAK RIGHT:	Signal 2
NEXT PEAK RIGHT:	Signal 3
NEXT PEAK RIGHT:	Signal 4

Setting **Peak Excursion 6dB** recognizes all the signals, *NEXT PEAK RIGHT* does not work as required.

Order of signals found:

PEAK:	Signal 1
NEXT PEAK:	Signal 2
NEXT PEAK:	Signal 4
NEXT PEAK:	Signal 3

or

PEAK:	Signal 1
NEXT PEAK RIGHT:	Marker in noise between signal 1 and signal 2
NEXT PEAK RIGHT:	Marker in noise between signal 1 and signal 2

The *SEARCH LIMIT ON/OFF* soft key switches between a limited (*ON*) and unlimited (*OFF*) search range.

For peak and min. search functions, the search range can also be limited by the frequency and time lines (FREQUENCY LINE 1, 2/TIME LINE 1, 2). If *SEARCH LIMIT = ON,* the appropriate signal level will only be searched for between the specified frequency/time lines.

The default setting is *SEARCH LIMIT = OFF.*

When only one line is enabled, frequency/time line 1 is defined as the lower limit and the upper limit is defined by the stop frequency. If frequency/time line 2 turned on, then it determines the upper limit.

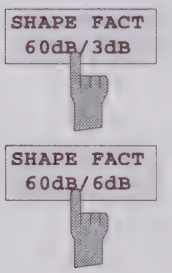
For the case in which no line is active the search range is unlimited.

The *N dB DOWN* soft key automatically activates the temporary markers T1 and T2 which are located n dB below the active reference marker. The marker T1 is located to the left, the marker T2 is located to the right of the reference marker. The value n can be entered in an entry window. The default value is 6 dB.

The frequency difference between the two temporary markers is shown in the level output field on the display screen.
If, e.g., due to the noise level, it is not possible to find the frequency difference for the n dB value, a broken line is displayed in the level output field.

Entry mode is switched to the reference marker for the case in which the delta maker entry mode is to be active. The position of the reference marker can be changed in the usual way (numeric input, step-keys, roll-key, peak search, etc.).

Pressing the *N dB DOWN* soft key again switches the function off, however, the entry function for the reference marker remains turned on.



The *SHAPE FACT 60dB/3dB*.and *SHAPE FACT 60dB/6dB* soft keys activate the automatic measurement of the form factor for the displayed signals.

For this purpose, four temporary markers are used. The markers T1 to T4 indicate, in increasing order, the 3 dB/6 dB positions below the reference marker level.

In the level output field, the relationship between the two frequency differences Δf_{60dB} / Δf_{3dB} and Δf_{60dB} / Δf_{6dB} are displayed

The display of the measurement value takes place in the marker field. When the level differences cannot be determined, the measurement value is marked as invalid. The update of the shape-factor display takes place at the end of sweep.

The entry mode is switched to the reference marker if the delta marker entry mode is to be active. The position of the reference marker can be changed in the usual way (numeric input, step-keys, roll-key, peak search, etc.).

The *SHAPE FACTOR* function is turned off by pressing *SHAPE FACTOR* soft key once again, or by enabling another marker.

The *SHAPE FACTOR* function is available only in the frequency domain.

2.9.3.3.1 Summary Marker

The summary markers are available for measurements in the time domain (SPAN = 0).

Unlike the markers and delta markers, the *summary markers* are not used to mark the pixels of a trace. They activate a measurement of the rms value (*RMS*) or of the average value (*MEAN*) of the whole trace. The result is displayed in the marker info field.

The measured values are either updated after every sweep or averaged according to a defined number of sweeps (*AVERAGE ON/OFF* and *SWEEP COUNT*). In case of maximum peak evaluation (*PEAK HOLD ON*) the measured values are held until the occurrence of the next higher value.

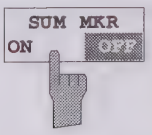
Example:
Marker info field switched on with summary marker: *MEAN*, *AVERAGE ON* and *PEAK HOLD ON*

```
MEAN HOLD      2.33 Watt
MEAN AV        2.29 Watt
```

The evaluation range can be limited with the function *SEARCH LIMITS ON* and the time lines (*TIME LINE1,2*), eg when measuring the average power of a sampled signal from the beginning to the end of a burst.

With the summary marker switched on, the sampling detector is activated (*TRACE-DETECTOR-AUTO*).

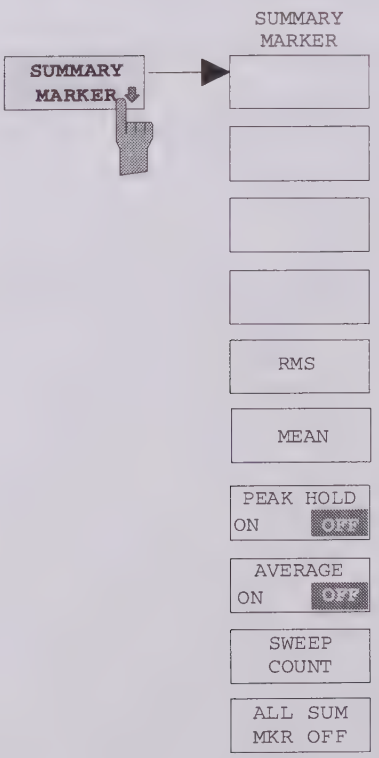
MARKER SEARCH menu



The *SUM MKR* soft key activates the summary marker

The measurement, rms or average value and the settings for maximum peak evaluation and averaging is selected in the submenu *SUMMARY MARKER*.

The soft key is only available in the time domain.



The *SUMMARY MARKER* soft key calls up the submenu for selecting the summary marker measurements.

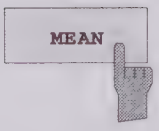
The soft key is only available in the time domain.

The *RMS* soft key selects the measurement of the rms value of the signal per sweep.

In case of maximum peak evaluation the highest rms value since the activation of *PEAK HOLD ON* is displayed.

In case of *AVERAGE ON* the rms values of a trace are averaged and displayed over several sweeps.

The number of sweeps is set with the *SWEEP COUNT* soft key. If *PEAK HOLD = ON* is active at the same time, the display is held until the occurrence of the next higher average value.



The *MEAN* soft key selects the measurement of the average value of the signal per sweep.

Thus, the mean power can be measured, for example during a GSM burst.

In case of maximum peak evaluation, the highest average value since the activation of *PEAK HOLD ON* is displayed.

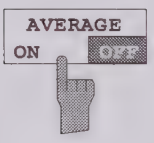
In case of *AVERAGE ON*, the average values of a trace are averaged and displayed over several sweeps.

The number of sweeps is set with the *SWEEP COUNT* soft key. If *PEAK HOLD = ON* is active at the same time, the display is held until the occurrence of the next higher average value.

The *PEAK HOLD ON/OFF* soft key switches the maximum peak evaluation on and off.

For all active summary markers, the displays are updated after each sweep only if higher values have occurred.

The measured values can be reset by switching the *PEAK HOLD ON / OFF* soft key on and off again.



The *AVERAGE ON/OFF* soft key switches the averaging of the summary markers on and off.

The measured values can be reset by switching the *AVERAGE HOLD ON / OFF* soft key on and off again.

The *SWEEP COUNT* soft key activates the entry of the number of sweeps in the *SINGLE SWEEP* mode.

The permissible range of values is 0 to 32767.

In case of *AVERAGE ON*:

If an averaging has been selected, SW*EEP COUNT* also determines the number of measurements required for averaging.

SWEEP COUNT = 0	10 measured values are required for running averaging.
SWEEP COUNT = 1	No averaging is carried out.
SWEEP COUNT > 1	An averaging is carried out over the set number of measured values.

In the *CONTINUOUS SWEEP* mode averaging is performed until the number of sweeps set under *SWEEP COUNT* is attained and then running averaging is performed.

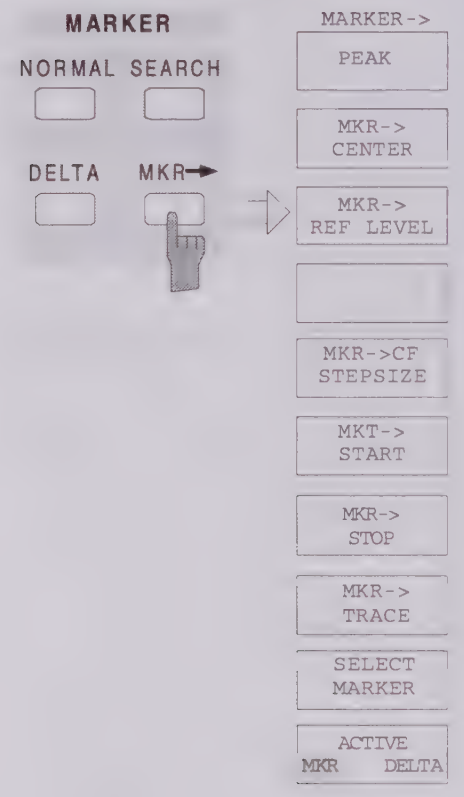
The maximum peak evaluation is infinite independent of the entry under *SWEEP COUNT*.

Note: *This setting is equivalent to the settings of the number of sweeps of menus TRACE and SWEEP-SWEEP.*

The *ALL SUM MKR OFF* soft key switches all the summary markers off.

2.9.3.4 Instrument Parameter Changes via Markers – *MKR → Key*

*MARKER MKR →*menu:



The *MKR →* menu offers functions through which instrument parameters can be changed with the aid of the currently active marker. Exactly as in the *SEARCH* menu, these functions can also be applied to the delta markers.

The choice between marker and delta marker is made according to the currently active frequency entry mode for the marker/delta marker. If no entry mode is active, the marker with the lowest number will be activated as the reference marker.

The *ACTIVE MKR /DELTA* soft key toggles between the active marker and the active delta marker.

If *DELTA* is illuminated, the following marker functions are carried out with the active delta marker.

Note: *Switching between marker and delta marker can also be done with the NORMAL and DELTA keys.*

To simplify control, the *PEAK* search function (see section "Search Functions - *SEARCH Key")* is also available in the *MRK→* menu. Thus, the most important functions *MARKER→PEAK*, *MKR→CENTER* and *MKR→REF LEVEL* can be selected in one menu.

The *MKR→CENTER* soft key sets the center frequency for the current marker/delta marker .

The soft key is not available in the time domain.

The *MKR→REF LEVEL* soft key sets the reference level to that of the current marker.

The *MKR→CF STEPSIZE* soft key sets the step size for the center frequency entry mode to the current marker frequency, and also sets step-size adaptation to *MANUAL*. The *CF STEP SIZE* remains at this value until the center frequency entry mode in the STEP menu is switched from *MANUAL* to *AUTO* again.

The *MKR→CF STEPSIZE* function is, above all, helpful in the measurement of harmonics with large dynamic range (narrow bandwidth and narrow span).

The soft key is not available in the time domain.

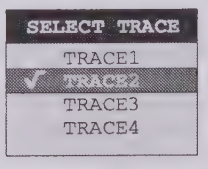
The *MKR→START* soft key sets the start frequency to the current marker frequency.

The soft key is not available in the time domain.

The *MKR→STOP* soft key sets the stop frequency to the current marker frequency.

The soft key is not available in the time domain.

The *MKR→TRACE* soft key opens a selection window through which the marker can be set to a new measurement curve. The traces available for selection appear in the window.



2.9.4 Setup of Display and Limit Lines – *LINES* Key Field

2.9.4.1 Display Lines – *D LINES Key*

Display lines are aids which, similar to markers, make the evaluation of measurement curve data more convenient. The function of display lines is similar to that of a movable scale which can be used to measure absolute and differential values on measurement curves.
In addition, the display lines can also be used to limit the range of search for marker functions.

The FSE provides four different types of display lines:

- two horizontal threshold lines for setting levels or for defining level search ranges – Display Line 1/2,
- two vertical frequency/time lines for indicating frequencies/times or for determining frequency or time search ranges – Frequency/Time Line 1/2,
- a threshold line which, for example, sets the search threshold for maximum levels (Peak Search) – Threshold Line
- a reference line which serves as the basis for mathematical correlation between measurement curves – Reference Line

For purposes of clarity, each line is annotated on the right side of the display diagram by the following abbreviations:

D1	Display Line 1	T1	Time Line 1
D2	Display Line 2	T2	Time Line 2
F1	Frequency Line 1	TH	Threshold Line
F2	Frequency Line 2	REF	Reference Line

The lines for level, threshold and reference are displayed as continuous, horizontal lines over the full width of the diagram. They are movable in the y-direction.
The lines for frequency and time are displayed as vertical, continuous lines over the total height of the diagram. They are movable in the x-direction.

For measurement operations in two separate windows, (Split Screen-Modus), the display lines are available independently in both windows. In the currently active window, the display lines can be activated and/or shifted. Lines previously defined in the currently inactive window remain unchanged.

The *LINES-D LINES* menu, used for switching on and setting the display lines, is dedicated to the chosen display in the active measurement window (span or time). For the display of a spectrum (span ≠ 0), the *FREQUENCY LINE 1* and *FREQUENCY LINE 2* soft keys appear, For the time display (span = 0), the *TIME LINE 1* and *TIME LINE 2* soft keys are displayed.

Note: *The soft keys for setting and switching the display lines on and off operate similar to a three-position switch:*

Initial condition: The line is switched off (soft key has grey background)

1st press: The line is switched on (soft key has red background) and data entry is activated. The position of the display line can be adjusted by using the roll-key, the step keys or through direct numerical inputs via the data-entry keypad. If some other arbitrary function is requested, the data-entry keypad is disabled. In this case, the display line remains switched on (soft key has green background).

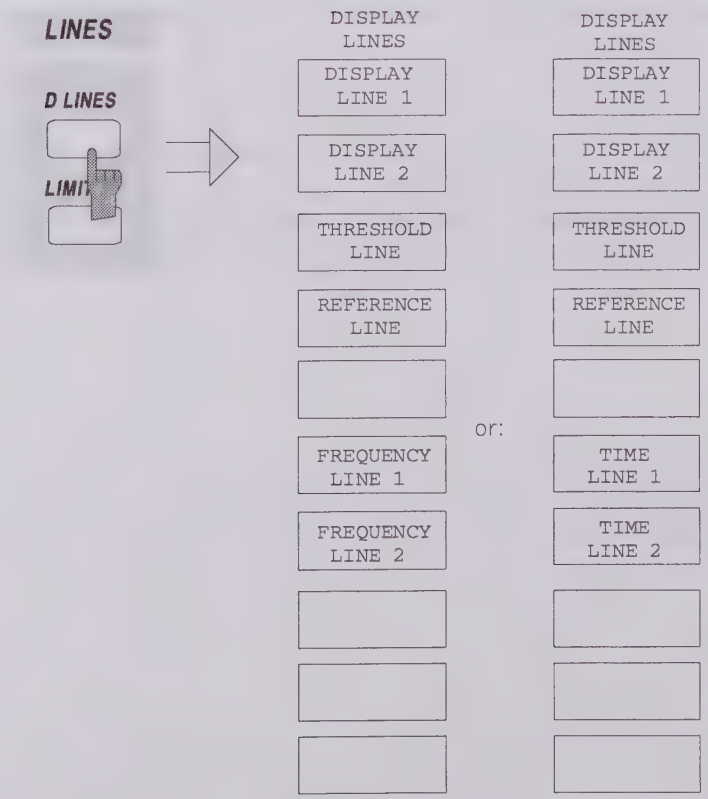
2nd press: The display line is switched off (soft key has grey background).

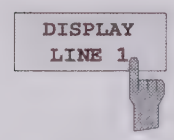
Initial condition: The line is switched on (soft key has green background)

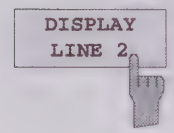
1st press: The line is switched on (soft key has red background) and data entry is activated. The position of the display line can be adjusted by using the roll-key, the step keys or through direct numerical inputs via the data-entry keypad. If any other arbitrary function is requested, the data-entry keypad is disabled. In this case, the display line remains switched on (soft key has green background).

2nd press: The display line is switched off (soft key has grey background).

Menu *LINES-D-LINES* for Span ≠ 0 for Span = 0

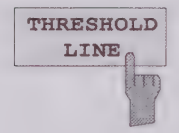






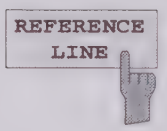
The *DISPLAY LINE 1/2* soft keys switch the display lines on/off and activate the entry of the line location.

The display lines mark the selected levels in the measurement window.



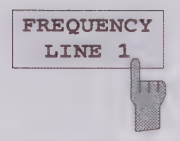
The *THRESHOLD LINE* soft key switches the threshold line on/off and activates the entry of the line location.

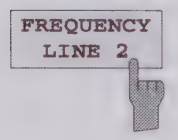
The threshold line is a display line which defines a threshold value. This threshold value serves as a lower search limit for maximums/minimums in the marker functions (*MAX PEAK, MIN PEAK, NEXT PEAK* etc.). For signal tracking (*SIGNAL TRACK function*), this threshold value defines the lower search limit (see section "Marker Functions")..



The *REFERENCE LINE* soft key switches the reference line on/off and activates the entry of the line position.

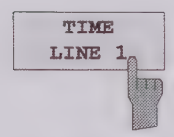
The reference line serves as the basis for mathematical correlation between measurement curve data (see section "Mathematical Operations on Measurement Curves"

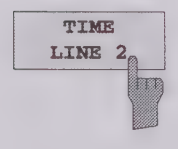




The *FREQUENCY LINE 1/2* soft keys switch the frequency lines 1/2 on/off and activate the entry of the line locations.

The frequency lines mark the selected frequencies in the measurement window or define search ranges (see section "Marker Functions").





The *TIME LINE 1/2* soft keys switch the time lines 1/2 on/off and activate the entry of line locations.

The time lines mark the selected times or define the search range (see section "Marker Functions").

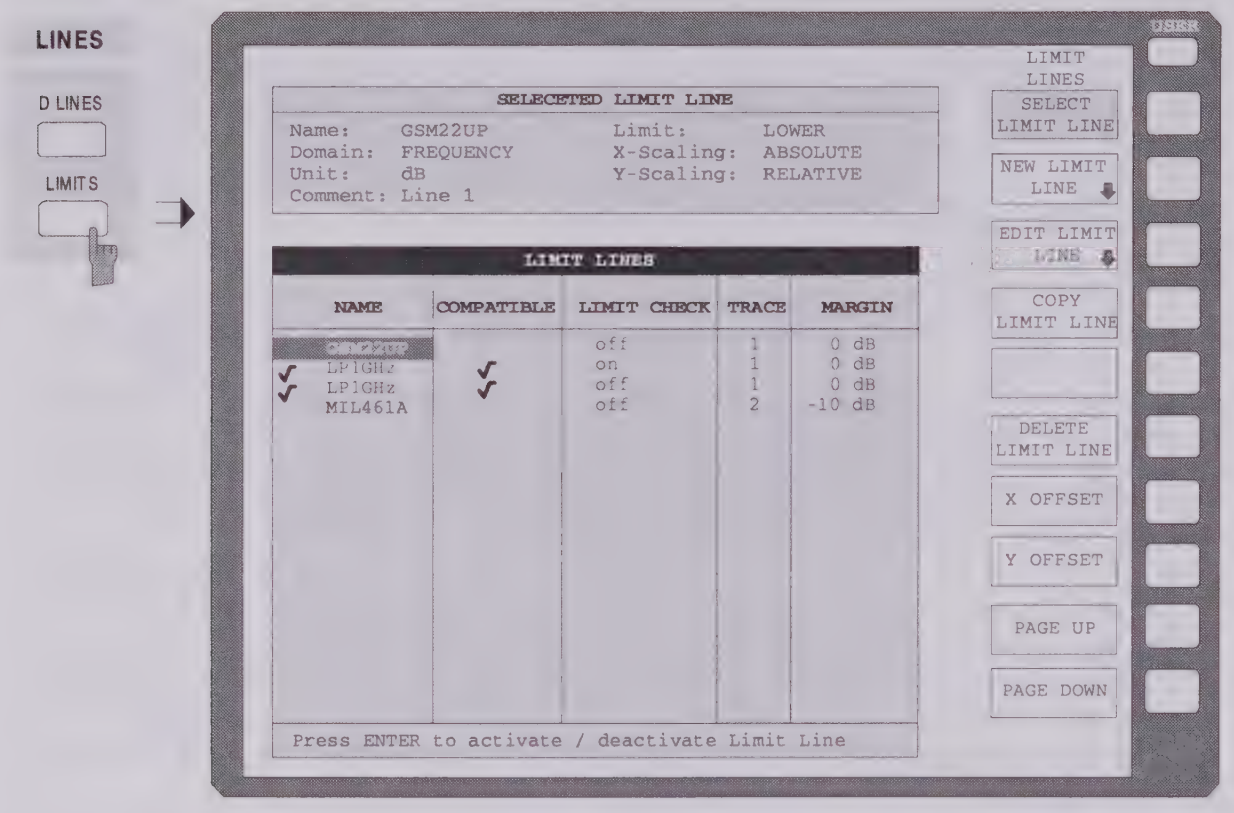
2.9.4.2 Limit Lines – *LIMITS Key*

Limit lines are used to define amplitude curves or spectral distribution boundaries on the display screen which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are permissible from a Unit Under Test (UUT). For transmission of information in TDMA (e.g., GSM), the amplitude of the bursts in a time slot must adhere to a curve which must fall within a specified tolerance band. The lower and upper limits may each be specified by a limit line. Then, the amplitude curve can be controlled either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).
The FSE instrument supports up to 300 limit lines, each of which may have a maximum of 50 data points. For each limit line, the following characteristics must be defined:

- The name of the limit line. The limit line data are stored under this name and can be examined in the table *LIMIT LINES.*
- The domain in which the limit line is to be used. Here, a distinction is made between the time domain (span = 0 Hz) and the frequency domain (span > 0 Hz).
- The reference of the interpolation points to the X-axis. The limit line may be specified either for absolute frequencies or times or for frequencies which are related to the set center frequency and times related to the time on the left edge of the diagram.
- The reference of the interpolation points to the Y-axis. The limit line can be selected either for absolute levels or voltages or referred to the set maximum level (Ref Lvl or Max Lvl). If the reference line is switched on, it is used as reference when relative setting has been selected.
- The type of limit line (upper or lower limit). With this information and the active limit checking function (*LIMIT CHECK* soft key), the FSE checks for compliance with each limit.
- The limit line units to be used. The units of the limit line must be compatible with the level axis in the active measurement window.
- The measurement curve (trace) to which the limit line is assigned. For the FSE, this defines the curve to which the limit is to be applied when several traces are simultaneously displayed.
- For each limit line, a margin can be defined which serves as a threshold for automatic evaluation.
- In addition, commentary can be written for each limit line, e.g., a description of the application.

In the *LINES LIMIT* menu, the compatible limit lines can be enabled in the *LIMIT LINES* table. The *SELECTED LIMIT LINE* display field provides information concerning the characteristics of the marked limit lines. New limit lines can be specified and edited in the *NEW LIMIT LINE and EDIT LIMIT LINE* sub-menus, respectively.

LINES LIMIT menu

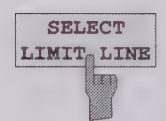


2.9.4.2.1 Limit Line Selection

The *SELECTED LIMIT LINES* table provides information about the characteristics of the marked limit line :

Name	name
Domain	frequency or time
Limit	upper/lower limit
X-Scaling	absolute or relative frequencies/times
Y-Scaling	absolute or relative Y-units
Unit	vertical scale
Comment	commentary

The characteristics of the limit line are set in the *EDIT LIMIT LINE (=NEW LIMIT LINE)* sub-menu.



The *SELECT LIMIT LINE* soft key activates the *LIMIT LINES* table and the selection bar jumps to the uppermost name in the table.

The following informations are offered in the columns of the table:

Name	Enable the limit line.
Compatible	Indicates if the limit line is compatible with the measurement window of the given trace.
Limit Check	Activate automatic violation check for upper/lower limits.
Trace	Select the measurement curve to which the limit is assigned.
Margin	Define margin.

***Name and Compatible* - Enabling limit lines**

A maximum of 8 limit lines can be enabled at any one time. A check mark at the left edge of a cell indicates that this limit line is enabled. A limit line can only be enabled when it has a check mark in the *Compatible* column, i.e., only when the horizontal display (time or frequency) and vertical scales are ***identical*** to those of the display in the measurement window.

Lines with the unit dB are compatible to all dB(..) settings of the Y-axis.
If the trace assigned to a line is not switched on, the line is displayed in the window the trace would be displayed in.

Example:
In split screen mode, trace 2 is assigned measuring window B. A line assigned to trace 2 is always displayed in measurement window B.

If the scale of the y-axis or the domain (frequency or time axis) are changed, all non-compatible limit lines are automatically switched off in order to avoid misinterpretation. The limit lines must be enabled anew when the original display is re-displayed.

***Limit Check* - Activate automatic limit violation check**

When *LIMIT CHECK ON* is activated, a GO/NOGO test is performed. In the center of the diagram, a display window appears which indicates the results of the limit check test:

LIMIT CHECK: PASSED	No violations of active limits.
LIMIT CHECK: FAILED	One or more active limit lines were violated. The message contains the names of the limit lines which were violated or whose margins were not complied with.
LIMIT CHECK: MARGIN	The margin of at least one active limit lines was not complied with, however, no limit line was violated. The message contains the names of the limit lines whose margins were not complied with.

The following example shows three active limit lines:

```
LIMIT CHECK: FAILED

LINE VHF_MASK: Failed
LINE UHF2MASK: Margin
```

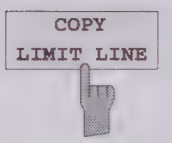
A check for violations of limit lines takes place only if the limit line of the assigned measurement curve (trace) is enabled.
If *LIM CHECK* is set to *OFF* for all active limit lines, then the limit line check is not executed and the display window is activated.

***Trace* - Select the measurement curve to which the limit line is assigned.**

The selection of the measurement curve (trace) takes place in an entry window. Allowed are the integer entries 1, 2, 3 or 4. The default setting is trace 1. If the selected limit line is not compatible with the assigned measurement curve, then the limit line is disabled. (display and limit check).

***Margin* - Setting a margin.**

The margin is defined as the signal-level distance to the limit line . When the limit line is defined as an upper limit, the margin means that the level is below the limit line. When the limit line is defined as a lower limit, the margin means that the level is above the limit line. The default setting is 0 dB (i.e., no margin).



The *COPY LIMIT LINE* soft key copies the data file describing the marked limit line and saves it under a new name. In this way, a new limit line can be easily generated by parallel translation or editing of an existing limit line. The name can be arbitrarily chosen and input via an entry window (max. of 8 characters).

Pressing the *DELETE LIMIT LINE* soft key erases the selected limit line. Before deletion, a message appears requesting confirmation.

The *X OFFSET* soft key is used to horizontally shift a limit line which has been specified for relative frequencies or times (X-axis). The soft key opens an entry window, where the value for shifting may be entered numerically or via the roll-key.

Note: *When changing the start or stop frequencies, the line on the display is only retained, if SPAN FIXED is set.*

The *Y OFFSET* soft key is used to vertically shift a limit line, which has relative values for the Y-axis (levels or linear units such as volt). The soft key opens an entry window where the value for shifting may be entered numerically or via the roll-key.

Pressing the *PAGE UP* soft key sets the limit line table to the next page.

Pressing the *PAGE DOWN* soft key sets the limit line table to the previous page.

2.9.4.2.2 Entry and Editing of Limit Lines

A limit line is characterized by

- its name
- the assignment of domain (frequency or time)
- the scaling in absolute or relative times or frequencies
- the vertical unit
- the vertical scaling
- the definition of the limit line as either upper or lower limit.
- the data points for frequency/time and level

At the time of entry, the FSE immediately checks that all limit lines are in accordance with certain guidelines. These guidelines must be observed if specified operation is to be guaranteed.

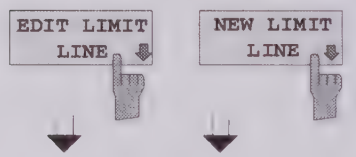
- The frequencies/times for each data point must be entered in ascending order, however, for any single frequency/time, twodata points may be input (vertical segment of a limit line).

  The data points are allocated in order of ascending frequency/time. Gaps are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.

- The entered frequencies/times must not necessarily be selectable in FSE. A limit line may also exceed the specified frequency or time domains. The minimum frequency for a data point is 0 Hz, the maximum frequency is 200 GHz. For the time domain representation, negative times may also be entered. The allowable range is -1000 s to +1000 s.

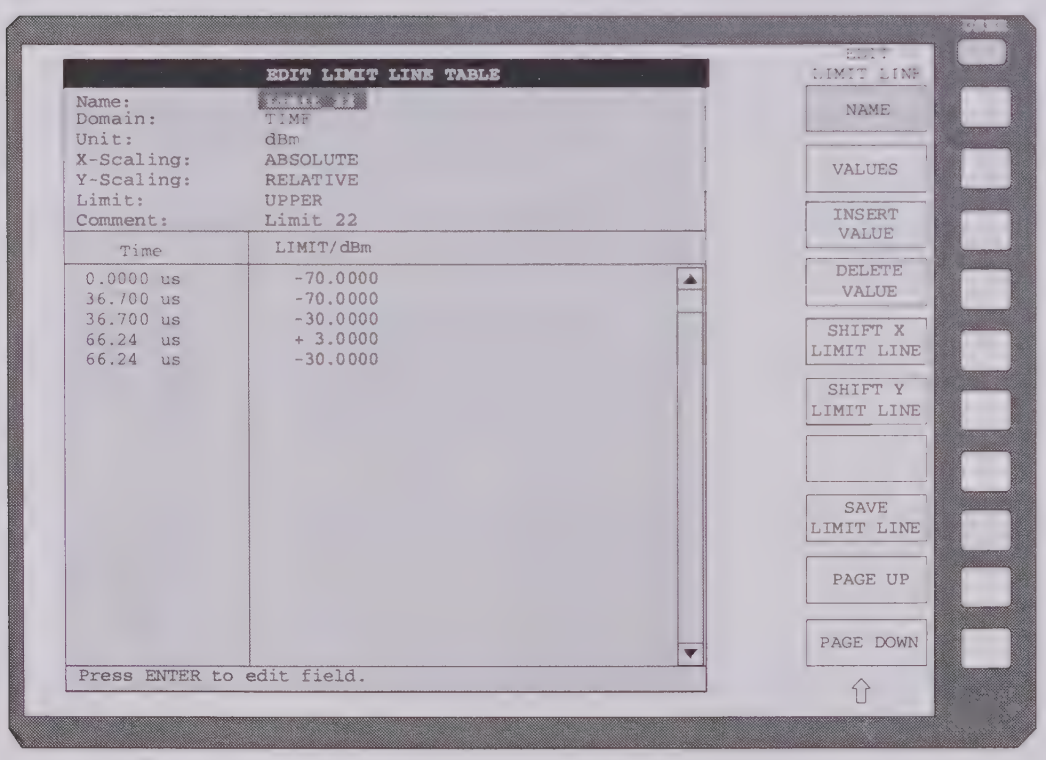
- The minimum/maximum value for a limit line is -200 dB to +200 dB for the logarithmic or 10^{-20} to 10^{+20} or-99.9% to + 999.9% for the linear amplitude scales.

LINES LIMIT-EDIT LIMIT LINE menu



The *EDIT LIMIT LINE* and *NEW LIMIT LINE* soft keys both call the *EDIT LIMIT LINE* sub-menu used for editing limit lines. In the table heading, the characteristics of the limit line can be entered. The data points for frequency/time and level values are entered in the columns.

Name	Enter name.
Domain	Select domain.
Unit	Select units.
X-Scaling	Entry of absolute or relative values for the X-axis
Y-Scaling	Entry of absolute or relative values for the Y-axis
Limit	Select upper/lower limit.
Comment	Enter comments.
Time/Frequency	Enter time/frequency for the data points.
Limit/dBm	Enter magnitudes for the data points.



The *NAME* soft key enables the entry of characteristics in the table heading.

***Name* - Enter name**

A maximum of 8 characters are permitted for each name. All names must be compatible with the MS DOS conventions for file names. The instrument stores all limit lines with the .LIM extension.

***Domain* - Select time or frequency domain**

A change in domain (frequency/time) is only permitted when the data point table is empty. The default setting is frequency.

***Scaling* - selection of absolute or relative scaling**

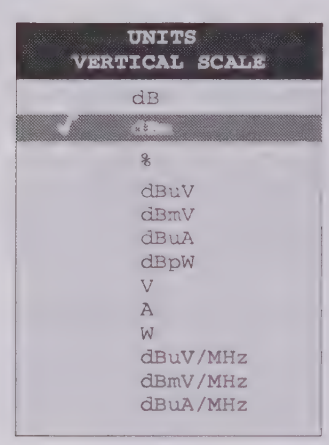
The limit line can either be scaled in absolute (frequency or time) or relative units. Any of the unit keys may be used to toggle between *ABSOLUTE* and *RELATIVE*, the cursor must be positioned in the X-*Scaling* or the *Y-Scaling* line

X-Scaling ABSOLUTE	The frequencies or times are interpreted as absolute physical units.
X-Scaling RELATIVE	In the data point table, the frequencies are referred to the currently set center frequency. In time domain mode, the left boundary of the diagram constitutes the reference.
Y-Scaling ABSOLUTE	The limit values refer to absolute levels or voltages.
Y-Scaling RELATIVE	The limit values refer to the reference level (Ref Level) or, in case a reference line is set, to the reference line. Limit values with the units dB or % are always relative values.

The *RELATIVE* scaling is always suitable, if masks for bursts are to be defined in the time domain, or if masks for modulated signals are required in the frequency domain.
An X-offset with half the sweep time may be entered in order to shift the mask in the time domain into the center of screen.

***Unit* - Select the vertical scale units for the limit line**

The selection of units takes place in a selection box. The default setting is dBm.



***Limit* - Select upper/lower limit**

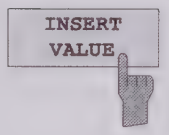
A limit line can be defined as either an upper or lower limit.

***Comment* - Enter comments**

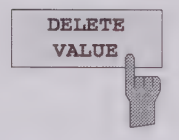
Comments are arbitrary, however, they must be less than 40 characters long.

The *VALUES* soft key activates the entry of the data points in the table columns *Time/Frequency* and *Limit/dB*. Which table columns appear depends upon the *Domain* selection in the table heading.

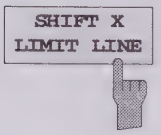
The desired frequency/time data points are entered in ascending order (two repeated frequencies/time values are permitted).



The *INSERT VALUE* soft key creates an empty line above the current cursor position where a new data point may be entered. However, during the entry of new values, it is necessary to observe an ascending order for frequency/time.



The *DELETE VALUE* soft key erases the data point (complete line) at the cursor position. All succeeding data points are shifted down accordingly.



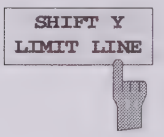
The *SHIFT X LIMIT LINE* soft key calls an entry window where the complete limit line may be shifted parallel in the horizontal direction.

The shift takes place according to the horizontal scale:

– in the frequency domain in Hz, kHz, MHz or GHz

– in the time domain in ns, µs, ms or s

In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally and stored (*SAVE LIMIT LINE* soft key) under a new name (*NAME* soft key).



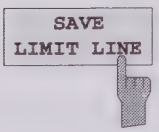
The *SHIFT Y LIMIT LINE* soft key calls an entry window where the complete limit line may be shifted parallel in the vertical direction.

The shift takes place according to the vertical scale:

– for logarithmic units, relative, in dB

– for linear units, as a factor

In this manner, a new limit line can be easily generated based upon an existing limit line which has been shifted vertically and stored (*SAVE LIMIT LINE* soft key) under a new name (*NAME* soft key).



The *SAVE LIMIT LINE* soft key stores the currently edited limit line . The name can be entered in an input window (max. 8 characters)

Pressing the *PAGE UP* soft key displays the next page of data points.

Pressing the *PAGE DOWN* soft key displays the previous page of data points.

2.9.5 Trace Selection and Setup –*TRACE Key Group*

The FSE is capable of displaying up to four separate traces at the same time. A trace consists of a maximum of 500 pixels on the horizontal axis (frequency or time). If there are more measurement values than pixels available, then several measurement values are collected together in one pixel.

The traces are selected using keys 1 to 4 of the *TRACES* key group. When two measurement windows (*SPLIT SCREEN*) are displayed, traces 1 and 3 are assigned to the upper (*SCREEN A)* and traces 2 and 4 are assigned to the lower (*SCREEN B)* measurement window.

The traces can be individually enabled for a measurement and, after the measurement is completed, held fixed. Traces which are not enabled remain dark.

For each trace, the type of display is selectable. The traces can be overwritten (CLEAR/WRITE mode) at each measurement, averaged (AVERAGE mode) over several measurements, or a maximum/ minimum value from several measurements can be determined and displayed.

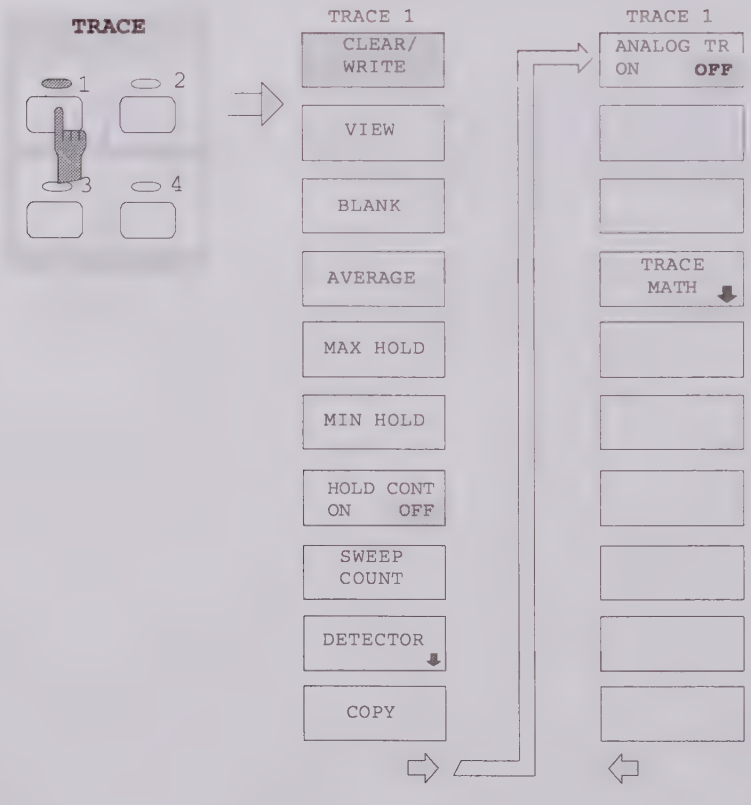
Individual detectors are selectable for the various traces. The auto-peak detector displays maximum and minimum values connected by a vertical line. The max-peak detector and min-peak detector display the maximum value/minimum value of the level within a pixel. The sampling detector displays the instantaneous value of the level at a pixel. The rms detector displays the power (rms value) of the measured values within a pixel, the average detector the average value.

2.9.5.1 Measurement Function Selection - *TRACE 1 to 4* key

The trace functions are partitioned as follows:

- type of trace display (CLEAR/WRITE, VIEW and BLANK)
- evaluation of the trace as a whole (AVERAGE, MAX HOLD and MIN HOLD)
- evaluation of the individual pixels of a trace (AUTOPEAK, MAX PEAK, MIN PEAK, SAMPLE, RMS and AVERAGE)

TRACE 1 menu



The *TRACE* keys 1...4 call a menu which presents the options for the selected trace.

In this menu, the method to be used for compressing the measurement data in the frequency or time domain to the 500 representable points of the display is determined.

At the beginning of the measurement, each trace can be displayed either completely new or based on previous measurement results.

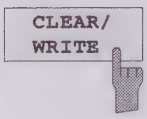
Traces can be displayed, blanked and copied.

By applying mathematical functions, the traces can also be corrected.

The measurement detector for each of the display types may be chosen either directly or selected automatically by the FSE.

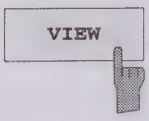
All activated traces are marked with a LED at the corresponding key (here, *TRACE 1)*. The default setting is *TRACE 1* with *CLEAR / WRITE* selected. The remaining traces 2...4 are switched off (*BLANK*). For the split screen display, the selection of the trace automatically selects the corresponding screen for entry.

The *CLEAR/WRITE, MAX HOLD, MIN HOLD, AVERAGE, VIEW,* and *BLANK* are mutually exclusive selection switches.



The *CLEAR/WRITE* soft key activates the clear/write display mode.
The trace is displayed without additional trace evaluation. The trace memory is overwritten by each sweep. If more than one data point falls within a pixel, the trace is displayed in bar form with the maximum and minimum values in a pixel connected. In the clear/write display mode, all the available detectors are selectable. The autopeak detector is selected in the default mode (detector to *AUTO*).

After each *CLEAR/WRITE* soft key action, the FSE clears the selected trace memory and starts the measurement anew.

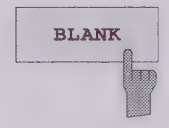


The *VIEW* soft key freezes the current contents of the trace memory and displays them on the display screen.

If the trace data were formed through *MAX HOLD*, *MIN HOLD* or *AVERAGE,* the sweep is restarted and the trace contents are cleared, after switching to these trace modes.

If a trace is frozen by *VIEW*, the instrument settings can be modified without modifying the displayed trace. The fact that the trace and the current instrument setting do not agree anymore is indicated by an enhancement label "*" at the right edge of the grid. The initial instrument setting can be restored using the *ADJUST TO TRACE* soft key in the *TRACE MATH* sub-menu.

If LEVEL RANGE or REF LEVEL is changed in the *VIEW* display mode, the FSE adjusts the measurement data to the changed display range. Thus, an amplitude zoom can be performed after the measurement so that details of the trace can be seen better.



The *BLANK* softkey removes the trace from the display screen. However, the trace data remain stored in memory and can be displayed again by *VIEW*. The markers for the blanked trace are also erased. If the trace is activated again (with *VIEW, CLEAR / WRITE, MAX HOLD, MIN HOLD, AVERAGE*) the markers will be restored to their original positions.

The *AVERAGE* soft key enables the trace averaging function. The average is taken from several foregoing measurements. The average can be calculated for each available detector. In case the detector is automatically selected by the FSE , the sampling detector is chosen.

After enabling the averaging mode, the first trace is recorded in *CLEAR/WRITE* mode with the selected detector. After the second sweep, the average is then formed for each succeeding sweep. Here, the average is formed over the samples/pixels, i.e., according to the LIN or LOG setting, over amplitudes or levels.

The average always starts anew when one of the AVERAGE soft keys is pressed. The trace memory is also cleared. This is also the case when the trace is switched from the setting *AVERAGE* to *VIEW* or *BLANK*

Description of the averaging procedure:

Averaging is carried out using the pixels which are derived from the measurement value samples. These pixels may in some cases be comprised of several combined measurement values. This means that the average is formed over linear amplitude values when the level display is linear and over levels when the level display is logarithmic. Because of this, the trace must be measured anew when changing between the LIN and LOG display mode. The settings *CONT/SINGLE SWEEP* and the running average apply to the average display analogously.

Two calculation procedures are available for averaging. For *SWEEP COUNT*= 0 , a running average is calculated according to the following equation:

$$TRACE = \frac{9 * TRACE + MEAS\_VALUE}{10}$$

Because of the distribution of the weighting between the new measurement value and the trace average, the measurement history has essentially no influence on the displayed trace after around 10 sweeps have taken place. For this setting, the signal noise is effectively reduced without the need for restarting the averaging process even if the signal is changed.

If, for *SWEEP COUNT* a value >1 is entered, the averaging takes place over the selected number of sweeps. In this case, the displayed trace is determined during averaging according to the following equation:

$$TRACE = \frac{(n-1) * TRACE + MEAS\_VALUE}{n}$$

where n is the number of the current sweep (n = 2 ... SWEEP COUNT). For the first sweep, an average is not calculated. The measurement values are stored directly in trace memory. With growing n, the displayed trace is increasingly smoothed since more individual trace data are available for averaging.
The average trace is stored in trace memory after the defined number of sweeps. Until this number of sweeps is reached, a preliminary average is displayed.

After completion of averaging, ie if the averaging length defined with *SWEEP COUNT* is attained, a running averaging is continued with *CONTINUOUS SWEEP* according to the following formula:

$$Trace = \frac{(N-1)\cdot Trace_{old} + meas.value}{N}$$, where Trace = new trace, $Trace_{old}$ = old trace, N = SWEEP COUNT

The display "Sweep 200 of 200" then remains constant until a new start is made.

In *SINGLE SWEEP* mode, *SWEEP START* initiates n single sweeps. The sweeps are stopped as soon as the selected number of sweeps is reached. The number of the current sweep and the total number of sweeps are shown in the display: "Sweep 3 of 200".

The *SWEEP COUNT* soft key activates the entry of the number of sweeps, over which an average is to be calculated.
The permitted range for SWEEP COUNT is 0 through 32767. For 0, the FSE performs a running average over 10 sweeps. For 1, no averaging takes place.

The default setting is 10 sweeps. The programming naturally influences the sweep duration. The number of sweeps which are used in the averaging process or the averaging time are valid **for all 4 traces**.

Note : *The setting of the SWEEP COUNT in the trace menu is equivalent to the setting in the sweep menu.*

The *MAX HOLD* soft key activates the max hold mode.
In this display mode, the FSE saves for each sweep the largest of the previously stored/currently measured values in the trace memory. The detector is set automatically to *MAX PEAK*. In this way, the maximum value of a signal can be determined over several sweeps.

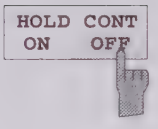
This is especially useful in the measurement of modulated or pulsed signals. The signal spectrum is filled at each sweep until all signal components have been captured.

By pressing of the *MAX HOLD* soft key again, the trace memory is cleared and the maximum value accumulation begins anew.

If *MAX HOLD* is enabled, a new start is made after clearing the trace memory for each frequency change, (start frequency, stop frequency, center frequency or frequency span), a reference level change or switching between linear/logarithmic scales.

The *MIN HOLD* soft key activates the min hold mode.
In this display mode, the FSE saves for each sweep the smallest of the previously stored/currently measured values in the trace memory. The detector is set automatically to *MIN PEAK*. In this way, the minimum value of a signal can be determined over several sweeps. This function is, e.g., useful in making an unmodulated carrier in a mix of signals visible. Noise, interference signals or modulated signals are suppressed by the *MIN HOLD* function while a CW signal maintains a constant level.

Pressing the *MIN HOLD* soft key clears the trace memory and the minimum value function starts anew.

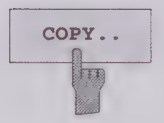


The *HOLD CONT* soft key defines whether the traces in the average mode and min hold/max hold mode are reset after some definite parameter changes.

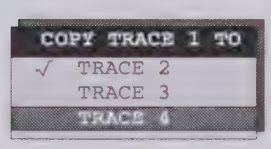
OFF The traces are reset after some definite parameter changes.

ON This mechanism is switched off.

In general, parameter changes require a restart of the measurement before results are evaluated (e. g. with markers). For those changes that are known to require a new measurement (e. g. modification of the span), the trace is automatically reset so that erroneous evaluations of previous results are avoided.
This mechanism can be switched off for those exceptional cases where the described behavior is unwelcome.



The *COPY* soft key copies the contents of the display screen for the current trace to another trace memory. A table appears in which the desired copy procedure can be selected.



For only one window, the selected trace can be copied to any of the other trace memories since here, all four traces are displayed in one diagram with the same frequency boundaries.
In the split screen display, this is only possible as long as the frequencies of screen A and screen B are identical. If this is not the case, the selected trace can only be copied to the corresponding trace memory, i.e., trace 1 to trace 3 and trace 2 to trace 4 or vice versa. In this case, only the available trace is displayed.

After copying, the contents of the destination memory are lost. The destination memory now changes automatically to view mode with the new data.

2.9.5.2 Detector Selection

The FSE detectors are realised by pure digital techniques . The detectors available are the max-peak detector which delivers the maximum value from a number of sample values, the min-peak detector which delivers the minimum value from a number of sample values and the sampling detector. The sampling detector can transfer the sampled data without modification or can perform a data reduction by suppressing non-displayable values. For the peak detectors, the current value is compared with the maximum/minimum levels of the previously sampled data. When the number of samples defined by the instrument settings is reached, the samples are collected into the available pixels. Thus, each of the 500 pixels of the display represents 1/500 of the sweep range and contains, in compressed form, all of the individual measurements (frequency samples) in this sub-range. Even though the recording rate is high, there are no recording gaps thanks to the internal pipeline structure. According to the trace display mode, an optimised detector is automatically applied. Since the peak detectors and the sample detector are connected in parallel, a single sweep is sufficient for recording and displaying four traces with four detectors.

Peak value detectors (*MAX PEAK* / *MIN PEAK*)

Peak value detectors are implemented by digital comparators, which determine the largest of all positive (max peak) or the smallest of all negative (min peak) peak values of the levels measured at the different frequencies which are displayed in one of the 500 pixels. This is repeated for each pixel so that, for wide frequency spans and inspite of the limited display resolution, a large number of measurements can be taken into consideration for the display of the spectrum.

AUTOPEAK detector

The *AUTOPEAK* detector combines the two peak detectors. The max-peak detector and min-peak detector determine the maximum and minimum level at a displayed test point at the same time and display it as a common measurement value. The maximum and minimum level at a frequency point are joined with a vertical line.

SAMPLE detector

The *SAMPLE* detector transfers all sampled data without further evaluation and either displays them directly or, for reasons of speed (short sweep times), first writes them into a memory and subsequently processes them.

Data reduction, i.e., summing of measurement values of neighbouring frequencies or time samples is not performed here. If, during a sweep, more measurement values are generated than can be displayed, measurement values will be lost. Discrete signals can thus be lost

Therefore, the sampling detector can only be recommended for a ratio of span-to-resolution bandwidth of up to approximately 250. Iit is thereby guaranteed that no signal will be suppressed (example: span 1 MHz --> min. bandwidth 5 kHz).

RMS detector

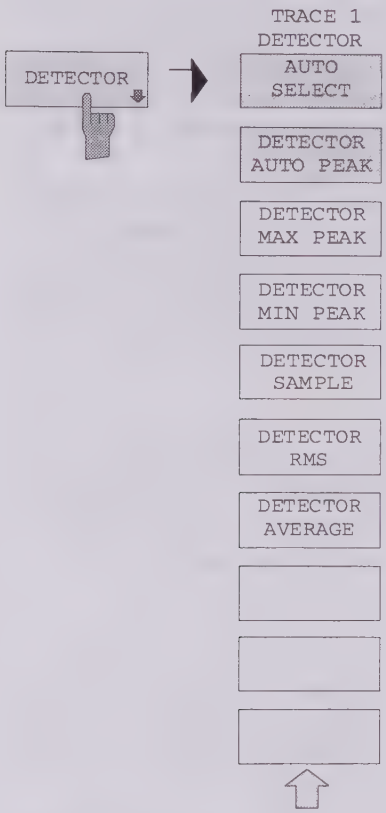
The rms detector forms the rms value of the measured values within a pixel.
To this effect FSE uses the linear display voltage after the envelope detection. The linear values are squared, summed and the sum is divided through the number of samples (= root mean square). In case of logarithmic display, the logarithm is then formed from the square sum. In case of linear display the root mean square is displayed directly. Each pixel thus corresponds to the power of the measured values summed up in the pixel.
The rms detector supplies the power of the signal independent of the waveform (CW carrier, modulated carrier, white noise or pulse signal). The correction factors required by other detectors for the power measurement of the different signal classes are omitted.

Average detector

The average detector forms the average value of measured values within a pixel.
To this effect, FSE uses the linear display voltage after the envelope detection. The linear sample values are summed up and the sum is divided by the number of measurement samples (= linear average value). In case of logarithmic display, the logarithm is then formed from the average value. In case of linear display the average value is displayed directly. Each pixel thus corresponds to the average value of the measured values summed up in the pixel.
The average detector supplies the average value of the signal independent of the waveform (CW carrier, modulated carrier, white noise or pulse signal).

Note: *During a sweep, the FSE switches the first oscillator in steps which are smaller than approximately 1/10 of the bandwidth. This guarantees that the level of a signal is correctly measured. For narrow bandwidths and wide spans, a very large number of measurement values are generated. The number of frequency steps is, however, always a multiple of 500 (= number of displayable points). In the sampling mode, only every n^{th} value is displayed. The quantity n depends upon the number of measurement values, i.e on the span, resolution bandwidth and the measurement rate.*

TRACE 1-DETECTOR submenu



The *DETECTOR* soft key opens a submenu to select the detector.

The detector type may be independently selected for each trace. Mode *AUTO SELECT* sets the best suitable detector for the type of trace display (Clear Write, Max Hold oder Min Hold).

The soft keys are mutually exclusive selection switches.

The *AUTO SELECT* soft key = default selects the optimum detector dependent upon the trace mode (clear write, max hold, min hold).

Trace-mode	Detector
Clear/Write	Autopeak
Average	Sample
Max Hold	Max Peak
Min Hold	Min Peak

The *DETECTOR AUTOPEAK* soft key selects the autopeak detector.

The *DETECTOR MAX PEAK* soft key selects the max peak detector. It is recommended if pulse-shaped signals are to be measured.

The *DETECTOR MIN PEAK* soft key selects the min peak detector. Weak sinewave signals become clearly visible in noise by using this detector. For a composite signal made up of sinewave and pulse signals the pulse signals are suppressed.

The *DETECTOR SAMPLE* soft key selects the sample detector.

It is used if uncorrelated signals like noise are to be measured. The power can be determined by means of fixed correction factors for evaluation and the log amplifier.

The DETECTOR RMS softkey activates the rms detector.

The rms detector supplies the power of the signal independent of the waveform. To this effect the root mean square of all sampled level values is formed during the sweep of a pixel. The sweep time thus determines the number of averaged values so that the trace can be better averaged with increasing sweep time. The rms detector is thus an alternative for averaging over several sweeps (see TRACE AVERAGE).

In the time domain (SPAN = 0), the rms detector is only available for sweep times ≥ 5 ms. Moreover, the combination of the rms detector with the pretrigger function and the gaped sweep function is not permissible.

The video bandwidth has to be set to at least 10 times the resolution bandwidth (RBW) so that the rms value of the signal is not invalidated by video filtering.

The *DETECTOR AVERAGE* softkey activates the average detector.

In contrast to the rms detector, the average detector supplies the linear average of all sampled level values during the sweep of a pixel.

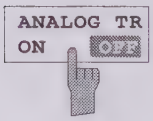
The same restrictions as those of the rms detector apply (see above).

2.9.5.3 Quasi Analog Display

Normally, measurement points are displayed interconnected by a continuous line. The leads to a continuous curve which is erased and rewritten for each new sweep. However, in the domain of analog measurement technology, display screen persistence leads to statistical emphasis which is related to the relative frequency of occurrence of a signal. Thus, on the display screen, frequently occurring events appear much brighter than rarely occurring curve segments.

Using the *ANALOG TRACE* function, the characteristics of an analog display are simulated. In this case, a measurement value is displayed as a single pixel on the display screen. This pixel is reset only by explicitly clearing the trace with *CLEAR / WRITE*. The overwriting of several sweeps is now possible and a frequency-of-occurrence distribution of the measurement values can be observed.

TRACE 1 side menu

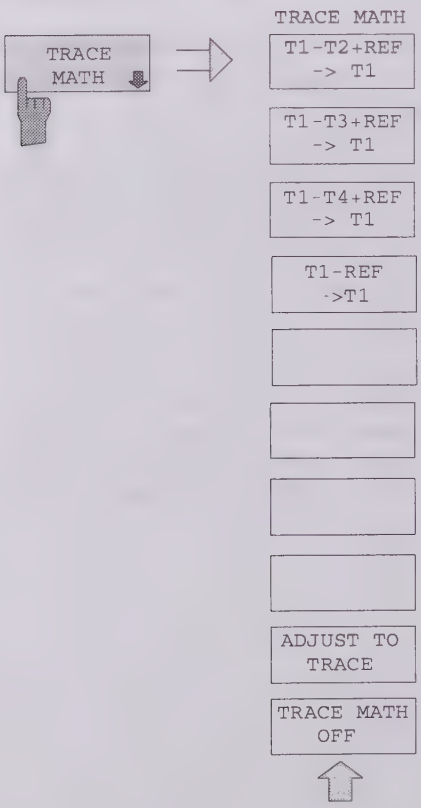


The ANALOG TR ON/OFF softkey enables/disables the *ANALOG TRACE* function for each trace.

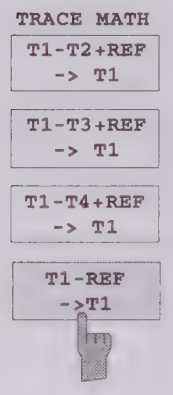
The measurement is always made with the selected detector.

2.9.5.4 Mathematical Functions for Traces

TRACE 1-TRACE MATH submenu:



The *TRACE MATH* soft key opens a sub-menu in which a differential curve for the selected trace is calculated.

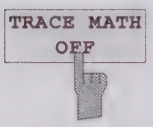


The *T1-T2+REF*, *T1-T3+REF*, *T1-T3+REF* and *T1-REF* soft keys subtract the corresponding traces and add the set level to the difference. If the reference line is switched on (see key D LINES), the level value of the reference line instead of the reference level is added to the difference. Thus, the differential curve can be positioned anywhere on the screen by shifting the reference line. The difference of the two traces with respect to the reference line is displayed.

The *T1-REF* soft key subtracts the level of the reference line from the trace level.

To indicate that the trace has been obtained by a differential curve, a corresponding enhancement label is displayed at the right margin of the measurement value diagram (1-2, 1-3, 1-4, 1-R). In *TRACE 1* main menu, the *TRACE MATH* soft key is on a coloured background to show that the function is being used.

***Important**: For a display with two measurement windows, not all combinations are allowed if the sweep data for screen A and screen B are not the same. Only the traces allowed in the screen can be combined (in screen A, only trace 1 with trace 3; in screen B, only trace 2 with trace 4).*



The *TRACE MATH OFF* soft key switches the enabled differential curve off. The soft key is only available when a conversion function is enabled.

The *ADJUST TO TRACE* soft key restores the original instrument settings when the corresponding trace is set to *VIEW* and the current instrument settings are different than those of the trace data.

If a trace is frozen with *VIEW*, changes in the instrument settings can be made without influencing the trace. An asterisk(*) at the edge of the display screen indicates that the current instrument settings are different than those in effect when the trace was recorded. In this case, the *ADJUST TO TRACE* soft key is presented with which the original instrument setting can be restored.

2.9.6 Sweep Control – *SWEEP Key Group*

Using the *SWEEP* key group, the parameters are entered which determine the sweep characteristics. These are the coupled functions resolution bandwidth, video bandwidth and sweep time (*COUPLING* key), the trigger used for starting the sweep (*TRIGGER* key) and the type of sweep (*SWEEP* key).

2.9.6.1 Coupled Settings – *COUPLING* Key

The *COUPLING* key calls a menu for entering the sweep parameters resolution bandwidth *(RBW)*, video bandwidth *(VBW)* and sweep time *(SWT)*. The parameters can be set dependent upon the span (stop - start frequency), coupled to each other or arbitrarily defined by the user. The settings for the split screen display mode are valid only for the window which is active for entries.

The models of the FSE family offer the following resolution bandwidths:

- models 20: 10 Hz to 10 MHz in 1/2/3/5 steps
- models 30: 1 Hz to 10 MHz in 1/2/3/5 steps

The FSE resolution bandwidths up to 1 kHz have been implemented using digital filters with Gaussian characteristics. They behave like analog filters. The 1-kHz filter has been implemented both as a decoupled quartz filter and as a digital filter. One of the two filter types can be selected. The bandwidths from 2 kHz to 30 kHz have been implemented using decoupled quartz filters, the bandwidths between 50 kHz and 5 MHz using decoupled LC filters. These filters consist of 4 circuits for models 20 and 5 circuits for models 30. Moreover, the filters for models 20 and 30 differ in their shape factor: The 60 dB :3 dB shape factor of the 4-circuit filters is < 15, typ. 12; the shape factor of the 5-circuit filters is < 12, typ. 9.5.

The 10-MHz filter is a critically coupled LC filter.

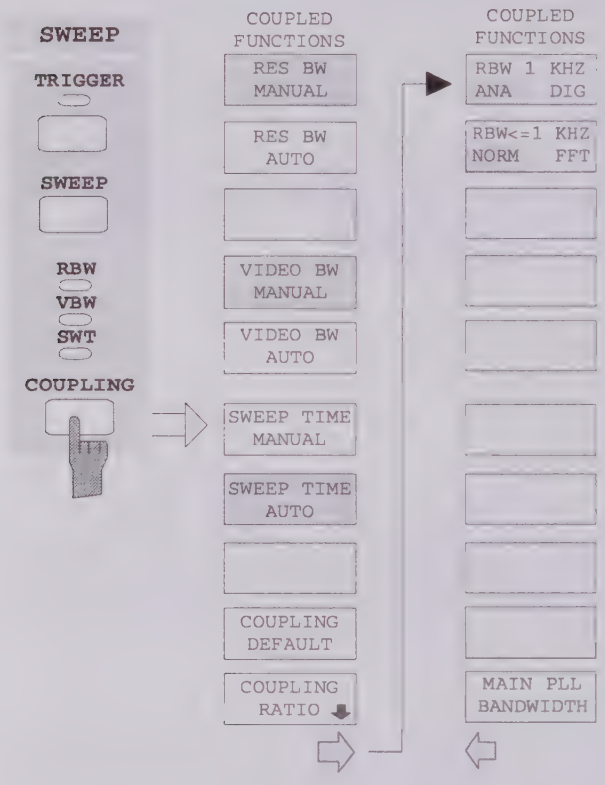
For bandwidths up to about 1 kHz, the FFT-algorithm, as compared to other filter methods with identical settings, offers clear advantages with respect to the measurement time. This is due to the fact that for analog filters the time required for a given display range is proportional to $(Span/RBW^2)$. The FFT-algorithm reduces that time to a value proportional to (Span/RBW).

FFT-filters are provided for models 30 and for bandwiths between 1 Hz and 1kHz as an alternative to the analog filters. This function is provided as an option (FSE-B5).

The video bandwidths are available in 1/2/3/5 steps between 1 Hz and 10 MHz. They can be set independent of the resolution bandwidth. Video bandwidths between 1 Hz and 10 kHz are available for resolution bandwidths up to 1 kHz and video bandwidths between 1 Hz and 10 MHz are available for resolution bandwidths greater than or equal to 2 kHz. The video filters are used to smooth the traces. Small video bandwidths in relation to the resolution bandwidth average out noise peaks pulse-like signals such that only the average value of the signals is displayed. A large video bandwidth in relation to the resolution bandwidth is therefore recommended when measuring pulsed signals (VBW ≥ 10 x RBW) so that the amplitude of pulses can be measured correctly.

2.9.6.1.1 Setting and Coupling the Coupling Resolution, Video Bandwidth and Sweep Time

SWEEP COUPLING menu



The *COUPLING* key calls a menu and a supplementary menu for setting the resolution bandwidth, video bandwidth, sweep time and their couplings.

The various *AUTO* soft keys are used to couple the functions. The coupling ratios are selected in the *COUPLING RATIO* sub-menu.

The various *MANUAL* soft keys request that the respective parameter be entered in the entry window. This parameter is not coupled to the other parameters.

The *RES BW AUTO* soft key couples the resolution bandwidth to the selected span. Changing the span causes automatic compensation of the resolution bandwidth.

Automatic coupling of resolution bandwidth to span is always recommended when, for the measurement problem on hand, a favorable setting of the resolution bandwidth in relation to the selected span is desired.

The coupling ratio is set in the *COUPLING RATIO* sub-menu.

The coupling is indicated by illumination of the soft key and the active *RBW* LED.

The *RES BW AUTO* soft key is only available in the frequency domain (span > 0 Hz). The soft key is blanked in the time domain.

The *RES BW MANUAL* soft key activates the manual entry mode for the resolution bandwidth.

The resolution bandwidth for models 20 can be set in 1/2/3/5 steps in the range between 10 Hz and 10 MHz. The nominal resolution bandwidth is the 3-dB bandwidth. For models 20 equipped with an FFT-filter (option FSE-B5) and for models 30 the lower limit of the bandwidth is 1 Hz.

For numerical inputs, the values are always rounded to the next valid bandwidth. For roll-key or the UP/DOWN key inputs, the bandwidth is adjusted in steps either upwards or downwards.

For manual input of the resolution bandwidth (coupling off), on the front panel remains off.

The *VIDEO BW AUTO* soft key couples the video bandwidth of the FSE to the resolution bandwidth. If the resolution bandwidth is changed, the video bandwidth is automatically adjusted.

The coupling of the video bandwidth is always recommended when the maximum sweep time for a selected resolution bandwidth is to be achieved. Lower video bandwidths require longer sweep times due to the longer settling time. Wider bandwidths reduce the signal/noise ratio.

The coupling ratio is set in the *COUPLING RATIO* menu.

The coupling is indicated by illumination of the soft key and the lighted *VBW* LED on the front panel.

The coupling of the video bandwidth to the resolution filter is also permitted for display in the time domain (span = 0).

The *VIDEO BW MANUAL* soft key activates the manual input mode for the video bandwidth.

The video bandwidth is selectable in 1/2/3/5 steps between 1 Hz and 10 MHz. For bandwidths up to 1 kHz, the maximum video bandwidth is 10 kHz, for larger resolution bandwidths, there is no restriction to the video bandwidth.

For numerical inputs, rounding is made to the next possible bandwidth. For roll-key or UP/DOWN entries, the bandwidth is switched in steps either downwards or upwards.

For manual input, the video bandwidth (coupling disabled) *VBW* LED on the front panel is turned off.

The *SWEEP TIME AUTO* soft key couples the sweep time to the span, video bandwidth (VBW) and resolution bandwidth (RBW). For a change in span, the resolution bandwidth or the video bandwidth is automatically matched to the sweep time. The FSE always selects the fastest sweep time which is possible without falsifying the level display.

The coupling is indicated by illumination of the soft key and turning on the *SWT* LED.

The soft key is only available in the frequency domain (span > 0 Hz). The soft key is blanked in the time domain.

The *SWEEP TIME MANUAL* soft key activates the manual input mode for the sweep time. At the same time, the coupling of the sweep is canceled and the *SWT* LED is turned off. Other couplings (*VIDEO BW, RES BW*) remain in effect.

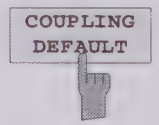
In the frequency domain (span > 0 Hz) and for resolution bandwidths ≥ 1 kHz, the allowed sweep times range from 5 ms through 16000 s in steps of 5% of the sweep time at maximum. The digital resolution filters from 10 Hz to 1 kHz allow a minimum sweep time of 20 ms.

If an FFT-filter is used (models 20 with option FSE-B5 or models 30) the sweep time is fixed by the display range and resolution bandwidth selected and therefore can not be set.

For displays in the time domain (span = 0 Hz), the range of sweep times 1 µs to 2500 s is selectable in steps of 5% of the sweep time at maximum.

For numerical inputs, rounding is made to the next possible sweep time. For roll-key or UP/DOWN entries, the sweep time is switched in steps either downwards or upwards.

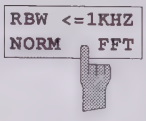
If the selected sweep time is too small for the selected span and bandwidth, measurement errors will occur. This happens because the available settling time for the resolution filter or the video filter is too short. In this case, the FSE outputs *UNCAL* on the display



The *COUPLING DEFAULT* soft key sets all coupled functions to *AUTO*. In addition, the ratio *RBW / VBW* is set to *SINE [1]* and the ratio *SPAN/RBW* is set to 50 in the *COUPLING RATIO* submenu (default setting, *COUPLING RATIO* soft key not illuminated).

The relevant soft keys are then illuminated.

The *RBW 1 kHz ANA/DIG* soft key enables either the analog quartz filter (ANA) or the digital filter (DIG) for the FSE's resolution bandwidth of 1 kHz. In the default setting, the FSE uses the analog IF filter for the 1-kHz bandwidth.



The *RBW<=1kHz NORM/FFT* soft key switches between fixed filter and FFT-filter.

This soft key for models 30 of the FSE or for models 20 equipped with option FFT-filter (FSE-B5).

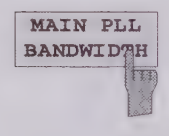
NORM For resolution bandwidths up to 1 kHz fixed IF-filters are used.

FFT An FFT is performed. To this end, the filtered IF-signal is digitalized by the 3-kHz resolution filters and then transformed into the spectral domain via FFT. The transformation range is equal to the selected display range but covers 4 kHz at maximum. If the display range is larger than the transformation range, serveral subsequent transformations are performed, the results are appended to each other in the spectral domain. This compensates for the frequency response of the 3-kHz preselection filter so that the amplitude response within the transformation range is offset. A flattop window seves as a window in the time domain so that a high amplitude precision with good selection is achieved.

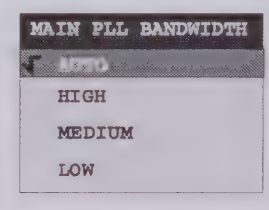
Span:
- minimum display range: 50× resolution bandwidth selected
- maximum display range:
  Resolution bwidths > 20 Hz: 2 MHz (500 FFT-transf./sweep at maximum)
  Resolution bwidths < 20Hz: Reduction to 125 kHz at 1 Hz resolution bandwidth

Level display range:	100 dB at max. A larger display range implies that the trace is tilted at –100 dB from the reference level.
Sweep time:	fixed by the bandwidth selected and the display range. (Reason: an FFT-filter represents a block transformation). The sweep time can not be changed (soft key inactive).
Detector	All settings of the sample detector are fixed, no other detector can be selected (softkeys inactive)
Video bandwidth	not defined for FFT-transf. so that it can not be set (softkeys inactive).

Compared to fixed filters, FFT-filters lead to markedly reduced sweep times. For a display range of 50 kHz and a resolution bandwith of 100 Hz, e. g., the sweep time is reduced from 25 s to 520 ms. FFT-filters are particularly suitable for stationary signals (sinusoidal signals or signals that are continuously modulated in time). For burst signals (TDMA) or pulses, fixed filters should be preferred. The FFT is a block transformation so that the result depends on the time relation between the dataset to be transformed and the burst or pulse signal. A 'gated sweep' measurement for TDMA signals is therefore not provided if FFT-filters are used.



The *MAIN PLL BANDWIDTH* soft key opens a selection window for setting the PLL control bandwidth.



The first local oscillator is synchronized with the PLL control bandwidth. The control bandwidth determines the characteristic of the phase noise. A medium or high control bandwidth improves the phase noise for frequency differences smaller than 10 kHz to the carrier, whereas a low control bandwidth improves the phase noise for frequency differences larger than 100 kHz to the carrier. If the control bandwidth is set unfavorably, the phase noise is deteriorated.

The PLL bandwidth is set in the AUTO mode depending on the RBW and SPAN according to the following tables:

Models 20 without option B4:

MAIN PLL BANDWIDTH	SPAN ≤ 50 kHz and RBW < 1kHz	SPAN > 50 kHz or RBW ≥ 1kHz
HIGH		
MEDIUM	X	
LOW		X

Models 30 or models 20 with Option B4:

MAIN PLL BANDWIDTH	SPAN ≤ 100 kHz and RBW < 3kHz	SPAN > 100 kHz or RBW ≥ 3kHz
HIGH	X	
MEDIUM		X
LOW		

The setting is chosen such that the phase noise for small spans with small resolution bandwidth near the carrier is optimized.

For measurements with small span but with a relatively large frequency difference to the carrier (>100kHz), the automatic bandwidth setting deteriorates the phase noise relative to the optimal setting. The *MAIN PLL BANDWIDTH* soft key allows to by-pass this automatic setting. Optimal settings are, as a function of the carrier difference @:

Models 20 without option B4:

MAIN PLL BANDWIDTH	@ ≤ 10 kHz	@ > 10 kHz
HIGH		
MEDIUM	X	
LOW		X

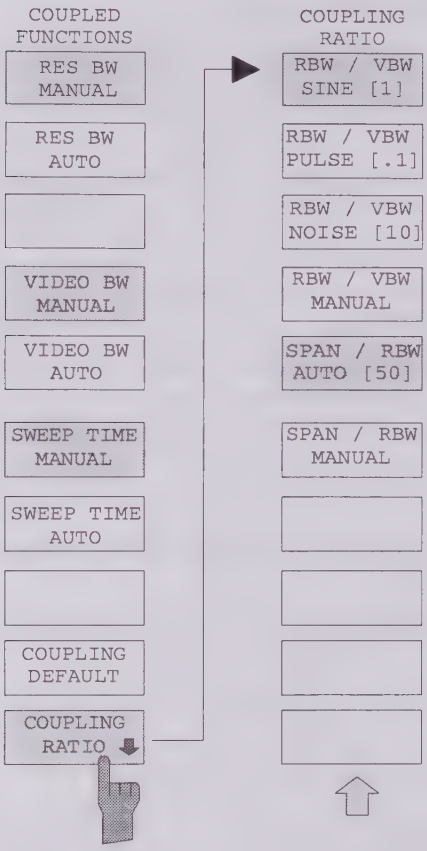
Models 30 or Models 20 with Option B4:

MAIN PLL BANDWIDTH	@ ≤ 10 kHz	10 kHz < @ < 100 kHz	@ ≥ 100 kHz
HIGH	X		
MEDIUM		X	
LOW			X

If a larger control bandwidth is needed due to the sweep velocity, the processor automatically increases the control bandwidth as far as necessary.

2.9.6.1.2 Sweep Coupling Ratio

SWEEP COUPLING-COUPLING RATIO submenu:

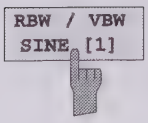


The *COUPLING RATIO* soft key opens a sub-menu in which the coupling ratio between resolution bandwidth, video bandwidth and the span can be defined.

These settings are effective only for the selected parameters in ...*AUTO* of the main menu.

The soft keys *RBW/VBW PULSE, RBW/VBW SINE, RBW/VBW NOISE, RBW/VBW MANUAL* are selection keys. Only one soft key can be enabled (illuminated) at any one time.

The same is valid for the soft keys *SPAN/RWB AUTO [50]* and *SPAN / RWB MANUAL*.

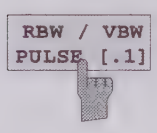


The *RBW / VBW SINE [1]* soft key always sets the video bandwidth equal to the resolution bandwidth.

This is the default setting for the coupling ratio resolution bandwidth to video bandwidth.

This coupling ratio is recommended when sine-wave signals are to be measured.

This setting is only effective for the *VBW AUTO* selection in the main menu.

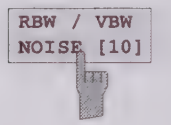


The *RBW / VBW PULSE* soft key sets the following coupling ratio:

video bandwidth = 10 x resolution bandwidth
or
video bandwidth = 10 MHz (= maximum video bandwidth).

This coupling ratio is always to be recommended when the amplitude of pulsed signal shape is to be measured. The IF filter characteristics alone determine the pulse shape. No additional weighting takes place via the video filter.

This setting is only effective for the *VBW AUTO* selection in the main menu.



The *RBW / VBW NOISE* soft key sets the following coupling ratio:
video bandwidth = resolution bandwidth/10

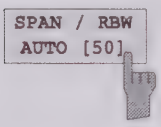
With this setting, noise and pulsed signals are suppressed in the video section. For noise signals, the FSE displays the average value.

This setting is only effective for the *VBW AUTO* selection in the main menu.

The *RBW / VBW MANUAL* soft key activates the coupling ratio for resolution bandwidth to video bandwidth.

The ratio of resolution bandwidth to video bandwidth can be set in the range from 0,001 to 1000.

This setting is only effective for the *VBW AUTO* selection in the main menu.



The *SPAN / RBW AUTO [50]* soft key sets the following coupling:
resolution bandwidth = span/50

This coupling corresponds to the default state.

This setting is only effective for the *RBW AUTO* selection in the main menu.

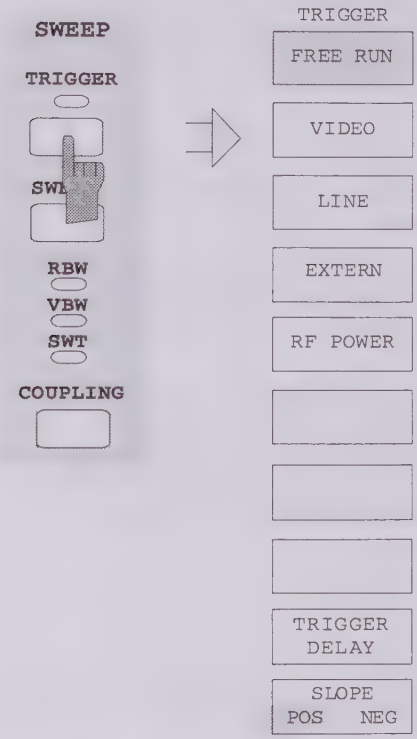
The *SPAN / RBW MANUAL* soft key activates the manual entry mode for the coupling of resolution bandwidth and span.

The ratio of resolution bandwidth to span can be in the range from 1 to 10000.

This setting is only effective for the *RBW AUTO* selection in the main menu.

2.9.6.2 Sweep Trigger – *TRIGGER Key*

SWEEP TRIGGER menu:



The *TRIGGER* key opens a menu for selection of the various trigger sources and the trigger polarity. The active trigger mode is indicated by illumination of the corresponding soft key.

For triggering modes in which the trigger threshold can be entered, the corresponding entry window is activated and, if appropriate, a horizontal trigger line is displayed.

The *FREE RUN, VIDEO, LINE, EXTERN* and *RF-POWER* soft keys are selection switches. Only one key can be enabled at any one time (illuminated). For sweep operations controlled by a gate signal, the *FREE RUN* setting is the only setting possible.

If triggering has taken place, the trigger LED is turned on at the beginning of the sweep and then turned off at the end of sweep.

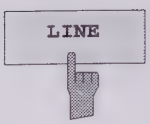
To indicate that the FSE is set for triggering (= not free run), the enhancement label **TRG** is shown on the display. If two measurement windows are displayed, TRG appears next to the window which is configured for triggering.

The *FREE RUN* soft key activates the free-run sweep mode (default setting).

In free-run sweep mode there is no triggering at the start of sweep.

The *VIDEO* soft key activates triggering by the displayed voltage.

For the video triggering mode, a level line showing the trigger threshold is displayed. Using the level line, the threshold can be adjusted with the roll-key or the UP/DOWN keys.

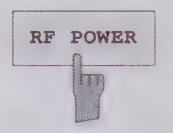


The *LINE* soft key activates triggering derived from the mains (line) frequency. The power supply generates a trigger pulse at the line frequency which is used to trigger a new sweep.

The *EXTERN* soft key activates triggering via an external voltage (-5V...+5V) at the input connector *EXT TRIGGER/GATE* on the rear panel.

The trigger threshold can be set in an entry window within a range of -5V...+5V.

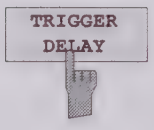
External triggering in the sweep mode "gated sweep" (*SWEEP SWEEP-EXT GATE ON)* is not possible, because the *EXT TRIG/GATE* connector is used to control the sweep. The soft key is not illuminated in these modes.



The *RF POWER* soft key activates triggering of the measurement via signals which are outside the measurement channel.

The FSE uses a level detector at the intermediate frequency. The detector threshold is approximately -20 dBm at the input mixer. This means that the actual trigger level at the RF input is approx. -20 dBm plus the set RF attenuation.

The bandwidth at the intermediate frequency is approximately 60 MHz for model FSEA, approx. 160 MHz for FSEB, FSEM and FSEK. Triggering takes place when the trigger threshold is exceeded within a 100 MHz bandwidth about the selected frequency. Thus, the measurement of noise emissions, e.g., for pulsed carriers, is possible. The carrier itself is suppressed via the selected resolution filter.



The *TRIGGER DELAY* soft key activates the entry window for delay time or a pretrigger.

The triggering is delayed or advanced relative to the trigger signal by the entered delay time. The delay time can be set in the range from -100 s to 100 s (default = 0 s).

Note: *A negative delay time (pretrigger) can be set in the time domain only (SPAN = 0 Hz).*

The *SLOPE POS/NEG* soft key selects the trigger slope.

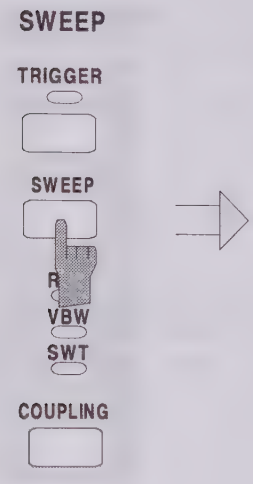
The sweep starts after a positive or negative edge of the trigger signal. The selected setting is illuminated.

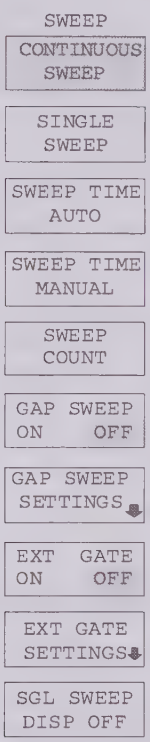
The selection is valid for all trigger modes with the exception of *FREE RUN.*

The default mode is *SLOPE POS.*

2.9.6.3 Sweep Setup – *SWEEP* Key

SWEEP SWEEP menu:

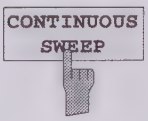




The *SWEEP* key calls a menu in which the type of sweep (sweep mode) is determined. In split screen mode, the entries are valid only for the active measurement window.

In the menu, continuous or single sweep mode, gap-sweep settings or the external gate function can be selected.

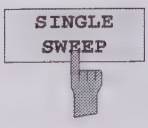
The *CONTINUOUS SWEEP* and *SINGLE SWEEP* soft keys are selection switches. Only one soft key can be active (illuminated) at any one time.



The *CONTINUOUS SWEEP* soft key sets the continuous sweep mode. This means, that the sweep takes place continuously according to the trigger conditions.

In case of split screen display with different settings in each measurement window, screen A is swept first and then screen B. After pressing the soft key, the sweep is initialized and restarted.

CONTINUOUS SWEEP is the default setting of FSE.



The *SINGLE SWEEP* soft key starts a series of n sweeps according to the triggering definition. The number of sweeps, n, is determined by the *SWEEP COUNT* soft key.

In split screen display mode, the spans of each window are swept sequentially. If a displayed curve is averaged, the span is swept n times (n = sweep count). For n = 0, a single sweep takes place.

SWEEPTIME AUTO

SWEEPTIME MANUAL

The *SWEEPTIME AUTO* and *SWEEPTIME MANUAL* soft keys activate the automatic or manual selection of the sweep time. These functions are identical to the entries in the *COUPLING* menu (see section 2.9.6.1.1).

The *SGL SWEEP DISP OFF* soft key switches off the display during a single sweep. The trace is displayed when the sweep has terminated.

The *SWEEP COUNT* soft key activates the entry of the number of sweeps performed by the FSE after the start of a single sweep. If trace average, max hold or min hold is switched on, this also fixed the number of averaging or minimum/maximum search procedures.

Example:
[**TRACE1**: *MAX HOLD*]
[**SWEEP**: *SWEEP COUNT*: {10} **ENTER**]
[*SINGLE SWEEP*]

The FSE performs the max hold function over 19 sweeps.

The permissible range for the sweep count is 0 through 32767. For sweep count = 0 or 1, a sweep is performed. For trace averaging *(AVERAGE)*, sweep count = 0 and continuous sweep, the FSE performs a running average over 10 sweeps in average mode. For sweep count = 1, no averaging takes place.

The default setting totals 10 sweeps.

Note: *The setting for the number of sweeps in the TRACE menu is equivalent to the setting in the SWEEP menu. In SINGLE SWEEP mode, the measurement is stopped after reaching the chosen number of sweeps.*

2.9.6.3.1 Gated Sweep

By using a gate in sweep mode and stopping the measurement while the gate signal is inactive, the spectrum for pulsed carriers can be displayed without overlaid frequency components caused by the on/off switching procedure. Similarly, the spectrum can also be examined for an inactive carrier. The sweep can be controlled by an external gate or by the internal power trigger.

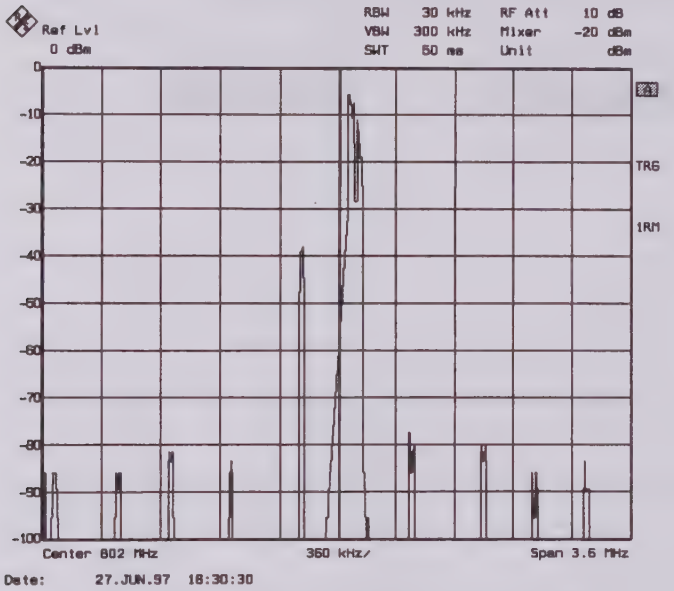


Fig. 2.9-5 Pulsed signal GATE

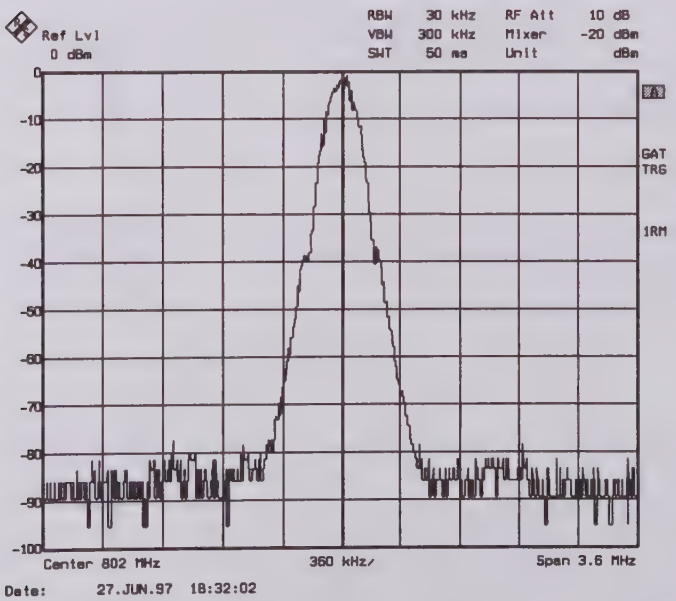


Fig 2.9-6 TDMA-signal with GATE ON

The 'gated sweep' mode is activated by the *EXT GATE ON/OFF* soft key. The setting of the mode takes place in the *GATE SETTINGS* sub-menu.

SWEEP SWEEP menu:

The *EXT GATE ON / OFF* soft key switches the sweep mode with an internal or external gate on/off.

When *GATE ON* is selected, a signal applied to the rear panel connector *EXT TRIGGER/GATE* or the internal RF power detector controls the sweep of the analyzer. The sweep can be stopped and then continued. A switch from an edge triggered to a level triggered mode can also be made.

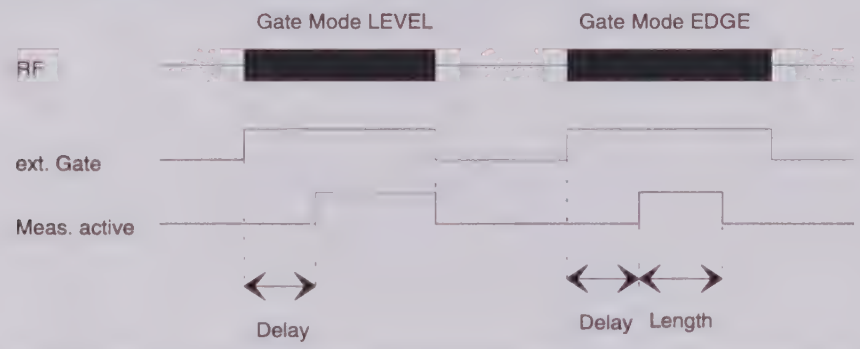


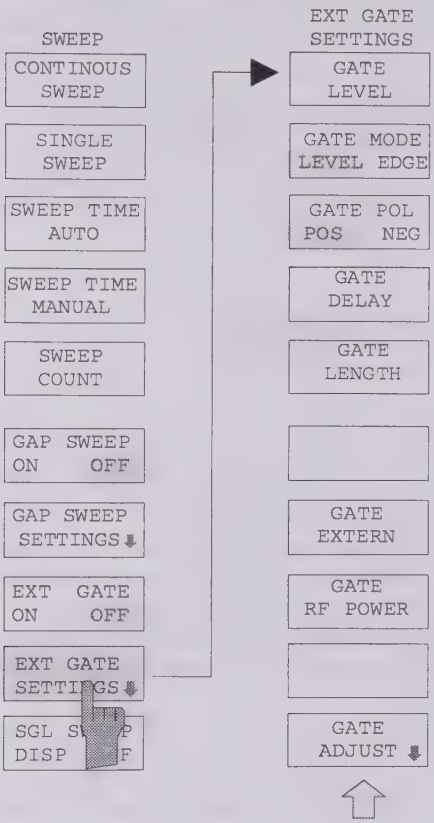
Fig. 2.9-7 Interaction of the parameters *GATE MODE*, *GATE DELAY* and *GATE LENGTH*

The soft key is only available in the frequency domain (span > 0).

GATE ON is only possible when the trigger mode is set to *FREE RUN* (*SWEEP TRIGGER* menu) .

To indicate that the FSE is set for sweep mode with external gate, the enhancement label GAT is shown on the display. GAT appears next to the window which is configured for sweep mode with external gate.

SWEEP SWEEP-EXT GATE SETTINGS sub-menu:



In the *GATE SETTINGS* sub-menu, all settings are made which are necessary for 'gated sweep' operation.

On switching to the time domain, the *GATE DELAY* and *GATE LENGTH* times are displayed by horizontal time lines which allow simple adjustment of the gate time.

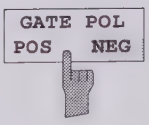
The soft keys *GATE EXTERN* and *GATE RF POWER* provide alternative settings, only one of them can be active at one time.

The *GATE LEVEL* soft key activates the entry window for defining the threshold value of the external gate signal.

The threshold can be set between -5V and +5V.

The *GATE MODE LEVEL/EDGE* soft key selects the trigger mode. The sweep mode *GATE* can be operated either as level or as edge triggered.

For level triggering, the *GATE LENGTH* soft key is deactivated and can not be used.



The *GATE POL* soft key determines the polarity of the *EXT GATE* control line.

If level triggering with *GATE POL POS* is set, the sweep is stopped when the gate signal is a logic ´ 0 ' (input signal < gate level) at the *EXT TRIGGER/GATE* input and then, when the gate signal goes to a logic ' 1 ', the sweep is continued after a delay time of *GATE DELAY*.

For edge triggering and a change from ' 0 ' to ' 1 ', i.e., the positive edge of the *EXT TRIGGER/GATE* input signal, the sweep is continued after a delay of *GATE DELAY* for a duration which was set by the *GATE LENGTH* soft key.

The *GATE DELAY* soft key activates the entry window for setting the delay time between the gate signal and the continuation of the sweep.

Thus, e.g., delays between the gate signal and the stabilization of an RF carrier can be taken into consideration.

For the gate delay time, values can be selected between 1 µs and 100 s. The resolution is dependent upon the absolute value of the delay time:

Gate delay	Resolution
0 - 500 µs	1 µs
0.5 - 5 ms	5 µs
5 - 50 ms	50 µs
50 - 500 ms	500 µs
0.5 - 5 s	5 ms
5 - 50 s	50 ms
50 - 100 s	500 ms

In the time domain, a time line is displayed separated from the trigger point by the gate delay time. This simplifies the adjustment of the necessary delay time.

The values for *GATE DELAY* and *GATE LENGTH* are displayed by two time lines. The duration of the active sweep for span > 0 (continuation of sweep: GATE DELAY line, stopping of sweep: GATE LENGTH line) is described by these two lines. A change in parameters causes a shift of the corresponding line position. After switching to span > 0, the selected times for the gated sweep are effective.

For edge triggering, the *GATE LENGTH* soft key activates the entry window for defining the FSE sweep duration.

GATE LENGTH can be set to values between 1µs and 100 s. The resolution is dependent upon the absolute value of the gate length:

Gate length	Resolution
0 - 500 µs	1 µs
0.5 - 5 ms	5 µs
5 - 50 ms	50 µs
50 - 500 ms	500 µs
0.5 - 5 s	5 ms
5 - 50 s	50 ms
50 - 100 s	500 ms

In the time domain *(ZERO SPAN)*, a time line is displayed separated from the *GATE DELAY* time by the *GATE LENGTH* time.

The soft key is only available for the *GATE MODE EDGE* setting (edge triggering). It is disabled for the *GATE MODE LEVEL* setting (level triggering).

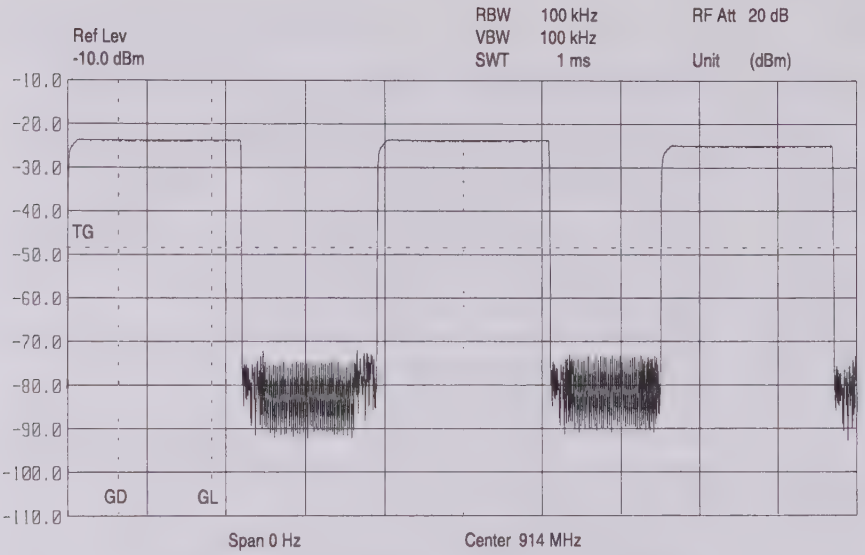
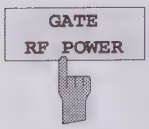


Fig. 2.9-8 Setting the GATE DELAY and GATE LENGTH times in the time domain using the GD and GL lines.

The *GATE EXTERN* and *GATE RF POWER*. soft keys are mutually exclusive selection switches. Only one switch can be active at any one time:

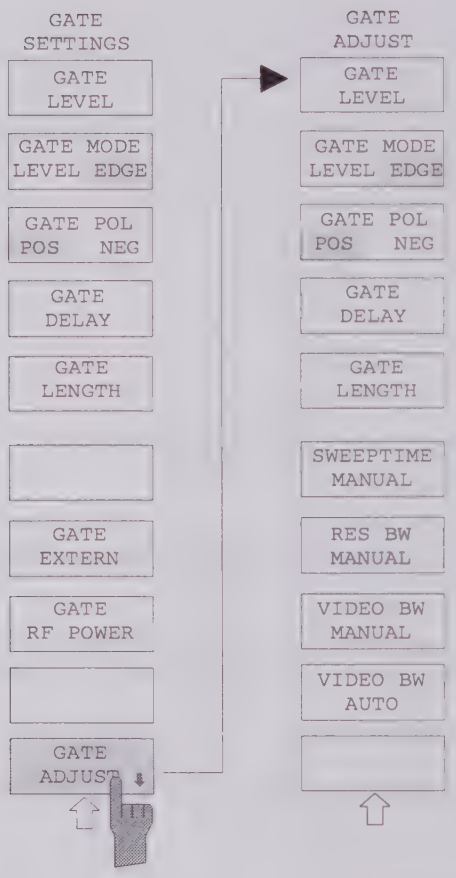
The *GATE EXTERN* soft key selects a signal applied to the *EXT TRIGGER/GATE* connector on the rear panel of the instrument as a gate source.



The *GATE RF POWER* soft key selects the internal RF power detector as a gate source.

Setting the Gate Times

SWEEP SWEEP- GATE SETTINGS - GATE ADJUST submenu:



The *GATE ADJUST* soft key opens a submenu comprising all soft keys that are used to set the parameters relevant for the 'gated sweep' function.

On pressing this soft key, the display is switched to the time domain (zero span setting) so that all necessary times can be checked by means of cursor lines.

The values for Res BW, Video BW and sweep time are taken from the corresponding settings in the frequency domain.

To make sure that the times can be set correctly corresponding to the conditions in the frequency domain, the settings for the resolution bandwidth and the video bandwidth should not be changed.

The sweep time must be selected such that, e. g., a full burst is displayed. It usually differs from the sweep time in the frequency range.

Finally, *GATE DELAY* and *GATE LENGTH* can be used to set the times in such a way that the desired section in the spectral range is covered.

On quitting the submenu, the original settings in the frequency range are restored so that the measurement can be directly performed with the required parameters.

Measurement example:

The modulation spectrum of a GSM or PCS1900 signal to be measured using the 'gated sweep' function. The signal is generated by the test sender SME03. Its RF-output is directly connected to the RF input of the FSE.

Settings on the SME03:

FREQ:	802 MHz
Level:	0 dBm: Return
Digital Mod:	Select: GMSK: Select
Source:	Select: PRBS: Select: Return
Level Attenuation:	Select: 60 dB: Return

The SME03 provides a GMSK-modulated TDMA-signal (GSM)

Operation steps on the FSE:

[PRESET]	
[CENTER:	{802} **MHz]**
[SPAN	{3.6} **MHz]**
[REF LVL:	{0} **dBm**: *RF ATTEN MANUAL*: {10} **dB]**
[COUPLING:	*RES BW MANUAL*: {30} **kHz]**
[TRACE 1:	*DETECTOR*: *RMS]*
[SWEEP:	*SWEEPTIME MANUAL*: {50} **ms**;
	GATE ON
	GATE SETTINGS: *GATE MODE EDGE: GATE POL POS: GATE RF POWER*
	GATE ADJUST: *SWEEPTIME MANUAL* {1} **ms**: *GATE DELAY* {300} **µs**: *GATE LENGTH*: {250} **µs]**

Note: ***[KEY]*** *Menu called by the KEY. All indications inside the bracket refer to this menu.*
{Number} *Numeric value to be entered for the corresponding parameter*
SOFTKEY *Soft key used to select a parameter or enter a value.*

The following figure shows the screen display for gate parameter setting: The vertical lines for gate delay (GL) and gate length (GL) can be adapted to the burst signal by entering numbers of by means of the rollkey.

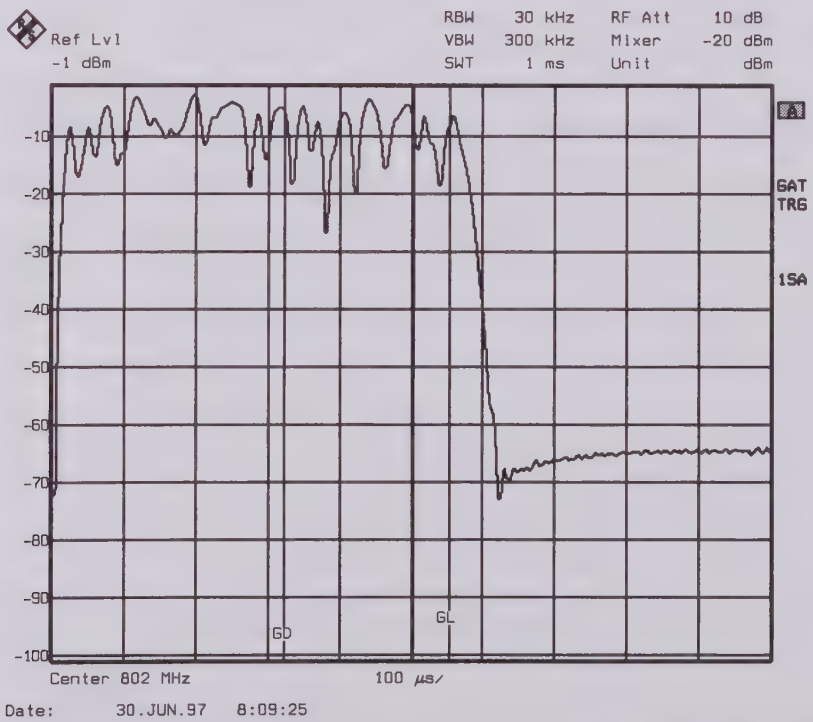


Fig. 2.9-9 Setting the GATE DELAY and GATE LENGTH times in the time domain using the GD and GL lines.

On quitting the menu *GATE ADJUST*, the FSE returns to spectral representation.

2.9.6.3.2 Sweep Blanking – Gap Sweep

For measurements in the time domain, the *GAP SWEEP* function offers a high degree of flexibility with regard to the display of measurement data. With the *PRE TRIGGER* soft key, it is possible to display measurements taken before the trigger time. With the *GAP TIME* soft key, the measurements within a predefined time range can be blanked. Thus, it is possible to display the rising and falling edge of a signal with high resolution on a single diagram.

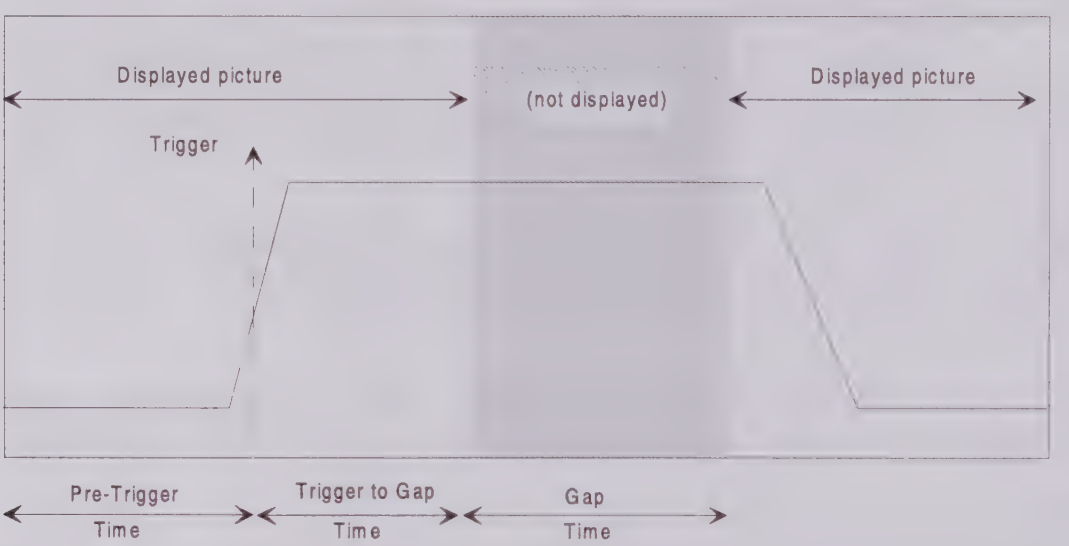


Fig 2.9-10 Trace blanking in sweep mode.– Gap Sweep

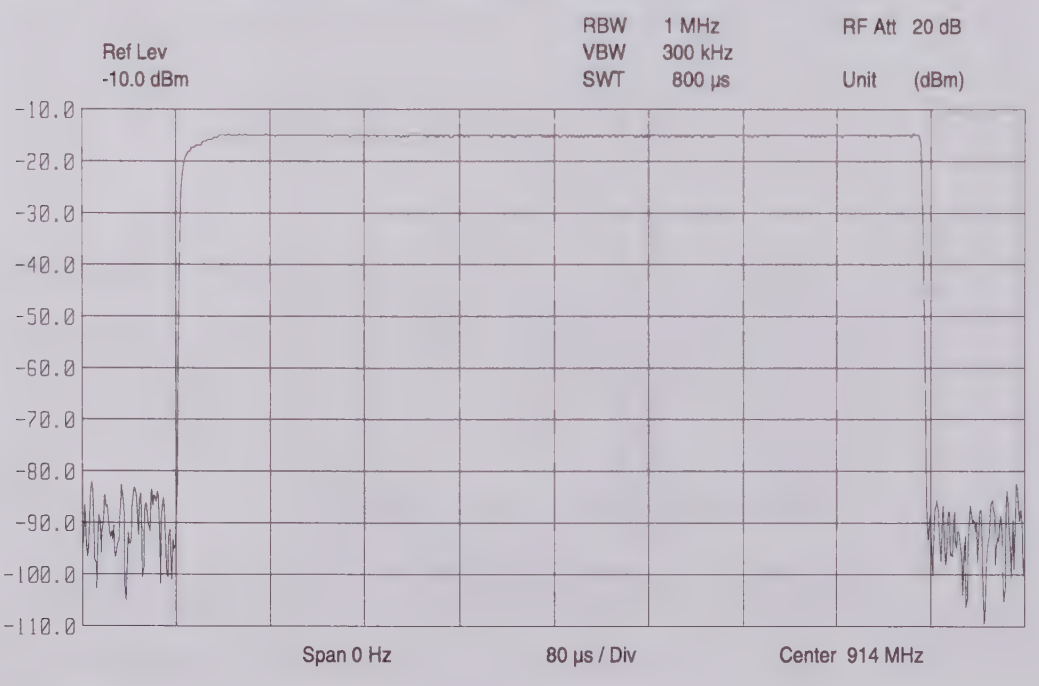


Fig. 2.9-11 Display of a burst without gaps.

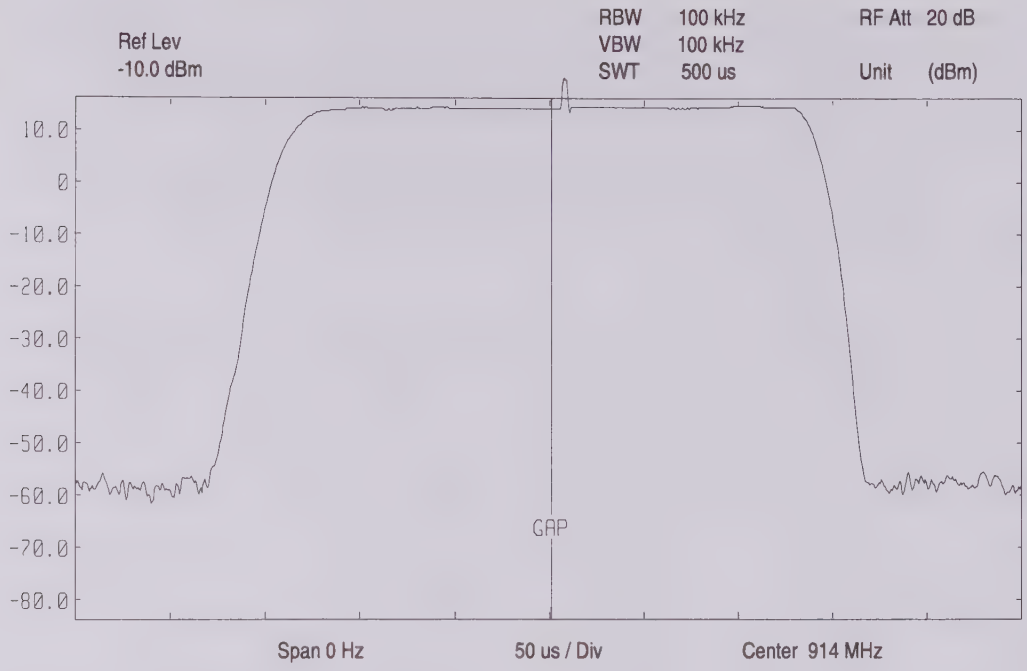


Fig. 2.9-12 Display of a burst with a gap

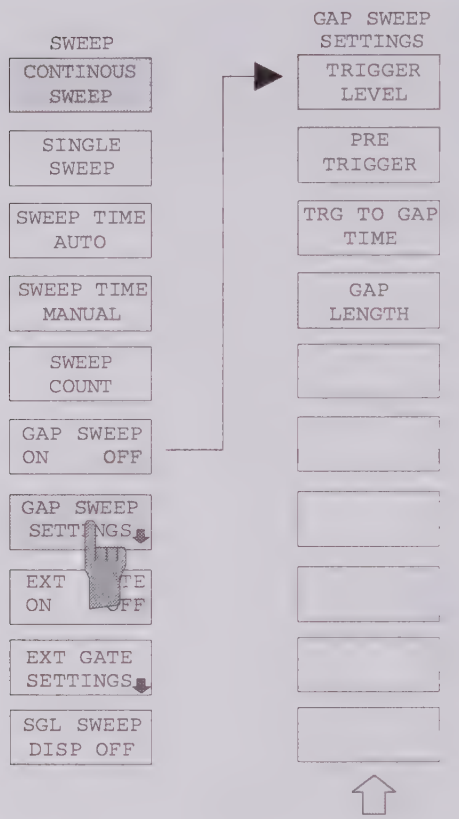
The GAP SWEEP measurement is activated by the GAP SWEEP *ON/OFF* soft key. The mode settings are made in the GAP SWEEP *SETTINGS* sub-menu.

SWEEP SWEEP menu:

The *GAP SWEEP ON/OFF* soft key switches the *GAP SWEEP* measurement on/off.

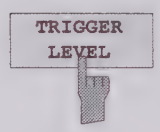
The soft key is available only in the time domain.

SWEEP SWEEP-GAP SWEEP SETTINGS sub-menu:



The *GAP SWEEP SETTINGS* soft key opens a sub-menu in which the parameters for the gap can be selected.

The trigger time corresponds to t = 0. Events occurring before the trigger time are displayed in negative time.



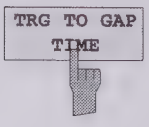
The *TRIGGER LEVEL* soft key activates the entry window for trigger level.

This function corresponds to the setting in the trigger menu.

The *PRE TRIGGER* soft key activates the entry window for the pre-trigger time. The pre-trigger time defines the separation between the left edge of the grid and the trigger time (t = 0).
At the same time the gap sweep is switched on (exception : entry t = 0)

The minimum pre-trigger time is –100 s, the maximum pre-trigger time depends on the sweep time and the trigger to gap time (max = 100 s). The maximum resolution is 50 ns.

The *PRE TRIGGER* value can be entered in the frequency domain (span > 0) as well as in the time domain and *GAP SWEEP OFF* mode. It is, however, only effective when the *GAP SWEEP* measurement is enabled.



The *TRG TO GAP TIME* soft key opens an entry window for defining the distance between the trigger time and the beginning of the gap.

The *TRIGGER TO GAP TIME* range is from 0 to 100 s with a resolution of 50 ns. The length of the gap is defined by *GAP LENGTH*. If the *GAP LENGTH* is 0 s, the entered value of *TRG TO GAP TIME* is only stored.

The *TRG TO GAP TIME* value can be entered in the frequency domain (span > 0) as well as in the time domain and for the *GAP SWEEP OFF* mode. It has an effect on the measurement only after the *GAP SWEEP ON* is switched on.

The *GAP LENGTH* soft key activates the entry window for defining the gap within which the measurement values are to be blanked.

The beginning of the gap is defined by *TRG TO GAP TIME*.

GAP LENGTH can be set to values between 150 ns and 100 s in 1/2/3/5 steps. The resolution is dependent upon the absolute value of the gap length:

Gap length	Resolution
150 ns - 50 µs	50 ns
50 - 500 µs	500 ns
0.5 - 5 ms	5 µs
5 - 50 ms	50 µs
50 - 500 ms	500 µs
0.5 - 5 s	5 ms
5 - 50 s	50 ms
50 - 100 s	500 ms

The *GAP LENGTH* value can be entered in the frequency domain (span > 0) as well as in the time domain and for the *GAP SWEEP OFF* mode. It has an effect on the measurement only after the *GAP SWEEP ON* is switched on.

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3 Remote Control

3.1 Introduction

The instrument is equipped with an IEC-bus interface according to standard IEC 625.1/IEEE 488.2 and two RS-232 interfaces. The connectors are located at the rear of the instrument and permits to connect a controller for remote control.

The option FSE-B15 (controller function) together with the option FSE B17 (2nd IEC-bus interface) may also be used as a controller (see Chapter 1, Section 1.8).

The instrument supports the SCPI version 1994.0 (Standard Commands for Programmable Instruments). The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers (see Section "SCPI Introduction").

This section assumes basic knowledge of IEC-bus programming and operation of the controller. A description of the interface commands is to be obtained from the relevant manuals.

The requirements of the SCPI standard placed on command syntax, error handling and configuration of the status registers are explained in detail in the respective sections. Tables provide a fast overview of the commands implemented in the instrument and the bit assignment in the status registers. The tables are supplemented by a comprehensive description of every command and the status registers. Detailed program examples of the main functions are to be found in annex D.

The program examples for IEC-bus programming are all written in Quick BASIC.

3.2 Brief Instructions

The short and simple operating sequence given below permits fast putting into operation of the instrument and setting of its basic functions. As a prerequisite, the IEC-bus address, which is factory-set to 20, must not have been changed.

1. Connect instrument and controller using IEC-bus cable.
2. Write and start the following program on the controller:

```
CALL IBFIND("DEV1", analyzer%)                    'Open port to the instrument
CALL IBPAD(analyzer%, 20)                         'Inform controller about instrument
                                                  'address
CALL IBWRT(analyzer%, "*RST;*CLS")                'Reset instrument
CALL IBWRT(analyzer%, "FREQ:CENT 100MHz")         'Set center frequency to 100 MHz
CALL IBWRT(analyzer%, "FREQ:SPAN 10MHz")          'Set span to 10 MHz
CALL IBWRT(analyzer%, "DISP:TRAC:Y:RLEV -10dBm") 'Set reference level to -10 dBm
```

The instrument now performs a sweep in the frequency range of 95 MHz to 105 MHz.

3. To return to manual control, press the *LOCAL* key at the front panel

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3.3 Switchover to Remote Control

On power-on, the instrument is always in the manual operating state ("LOCAL" state) and can be operated via the front panel.
It is switched to remote control ("REMOTE" state)

IEC-bus as soon as it receives an addressed command from a controller.

RS-232 as soon as it receives the command "@REM" from a controller.

During remote control, operation via the front panel is disabled. The instrument remains in the remote state until it is reset to the manual state via the front panel or via remote control interfaces. Switching from manual operation to remote control and vice versa does not affect the remaining instrument settings.

3.3.1 Remote Control via IEC Bus

3.3.1.1 Setting the Device Address

In order to operate the instrument via the IEC-bus, it must be addressed using the set IEC-bus address. The IEC-bus address of the instrument is factory-set to 20. It can be changed manually in the *SETUP - GENERAL SETUP* menu or via IEC bus. Addresses 0 to 30 are permissible.

Manuell: Call *SETUP - GENERAL SETUP* menu

Enter desired address in table *GPIB ADDRESS*

Terminate input using one of the unit keys (=ENTER).

Via IEC bus:

```
CALL IBFIND("DEV1", analyzer%)                    'Open port to the instrument
CALL IBPAD(analyzer%, 20)                         'Inform controller about old address
CALL IBWRT(analyzer%, "SYST:COMM:GPIB:ADDR 18")   'Set instrument to new address
CALL IBPAD(analyzer%, 18)                         'Inform controller about new address
```

3.3.1.2 Indications during Remote Control

Remote control mode is indicated by the LED "REMOTE" on the instrument's front panel. In this mode the softkeys on the display are not shown.

3.3.1.3 Return to Manual Operation

Return to manual operation is possible via the front panel or the IEC bus.

Manually: Press the *LOCAL* key.

Notes:
- *Before switchover, command processing must be completed as otherwise switchover to remote control is effected immediately.*
- *The LOCAL key can be disabled by the universal command LLO (see annex A) in order to prevent unintentional switchover. In this case, switchover to manual mode is only possible via the IEC bus.*
- *The LOCAL key can be enabled again by deactivating the REN line of the IEC bus (see annex A).*

Via IEC bus:

```
...
CALL IBLOC(analyzer%)          'Set instrument to manual operation.
...
```

3.3.2 Remote Control via RS-232-Interface

3.3.2.1 Setting the Transmission Parameters

To enable an error-free and correct data transmission, the parameters of the unit and the controller should have the same setting. Parameters can be manually changed in menu *SETUP-GENERAL SETUP* in table *COM PORT 1/2* or via remote control using the command `SYSTem:COMMunicate:SERial1|2:....`

The transmission parameters of the interfaces COM1 and COM2 are factory-set to the following values: baudrate = 9600, data bits = 8, stop bits = 1, parity = NONE and protocoll = NONE.

Manually: Setting interface COM1|2

Call *SETUP-GENERAL SETUP* menu

Select desired baudrate, bits, stopbit, parity and protocoll in table *COM PORT 1/2.*

Terminate input using one of the unit keys (=ENTER).

3.3.2.2 Indications during Remote Control

See Section 3.3.1.2.

3.3.2.3 Return to Manual Operation

Return to manual operation is possible via the front panel or via RS-232 interface.

Manually: Press the *LOCAL* key.

Note:
- *Before switchover, command processing must be completed as otherwise switchover to remote control is effected immediately.*
- *The LOCAL key can be disabled by the universal command LLO (see annex A) in order to prevent unintentional switchover. In this case, switchover to manual mode is only possible via the IEC bus.*
- *The LOCAL key can be enabled again by sending the command "@LOC" via RS-232 (see annex A).*

Via RS-232:

```
...
V24puts(port, "@LOC");      Set instrument to manual operation.
...
```

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3.4 IEC-Bus Messages

The messages transferred via the data lines of the IEC bus (see annex A) can be divided into two groups:

- **interface messages and**
- **device messages.**

For the RS-232 interface, no interface messages are defined.

3.4.1 Interface Messages

Interface messages are transferred on the data lines of the IEC bus, the "ATN" control line being active. They are used for communication between controller and instrument and can only be sent by a controller which has the IEC-bus control. Interface commands can be subdivided into

- **universal commands and**
- **addressed commands.**

Universal commands act on all devices connected to the IEC bus without previous addressing, addressed commands only act on devices previously addressed as listeners. The interface messages relevant to the instrument are listed in annex A.

Some control characters are defined for the control of the RS-232-interface (see annex A).

3.4.2 Device Messages (Commands and Device Responses)

Device messages are transferred on the data lines of the IEC bus, the "ATN" control line not being active. ASCII code is used. The device messages are more or less equal for the 2 interfaces (IEC-bus and RS-232).
A distinction is made according to the direction in which they are sent on the IEC bus:

– **Commands** are messages the controller sends to the instrument. They operate the device functions and request informations.
The commands are subdivided according to two criteria::

1. According to the effect they have on the instrument:

   Setting commands cause instrument settings such as reset of the instrument or setting the center frequency.

   Queries cause data to be provided for output on the IEC-bus, e.g. for identification of the device or polling the marker.

2. According to their definition in standard IEEE 488.2:

   Common Commands are exactly defined as to their function and notation in standard IEEE 488.2. They refer to functions such as management of the standar-dized status registers, reset and selftest.

   Device-specific commands refer to functions depending on the features of the instrument such as frequency setting. A majority of these commands has also been standardized by the SCPI committee (cf. Section 3.5.1).

– **Device responses** are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status (cf. Section 3.5.4).

Structure and syntax of the device messages are described in Section 3.5. The commands are listed and explained in detail in Section 3.6.

3.5 Structure and Syntax of the Device Messages

3.5.1 SCPI Introduction

SCPI (Standard Commands for Programmable Instruments) describes a standard command set for programming instruments, irrespective of the type of instrument or manufacturer. The goal of the SCPI consortium is to standardize the device-specific commands to a large extent. For this purpose, a model was developed which defines the same functions inside a device or for different devices. Command systems were generated which are assigned to these functions. Thus it is possible to address the same functions with identical commands. The command systems are of a hierarchical structure.
Fig. 3.5-1 illustrates this tree structure using a section of command system SOURce, which operates the signal sources of the devices. The other examples concerning syntax and structure of the commands are derived from this command system.
SCPI is based on standard IEEE 488.2, i.e. it uses the same syntactic basic elements as well as the common commands defined in this standard. Part of the syntax of the device responses is defined with greater restrictions than in standard IEEE 488.2 (see Section "Responses to Queries").

3.5.2 Structure of a Command

The commands consist of a so-called header and, in most cases, one or more parameters. Header and parameter are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several key words. Queries are formed by directly appending a question mark to the header.

Note: *The commands used in the following examples are not in every case implemented in the instrument.*

Common commands

Common commands consist of a header preceded by an asterisk "*" and one or several parameters, if any.

Examples:

`*RST`	RESET, resets the device
`*ESE 253`	EVENT STATUS ENABLE, sets the bits of the event status enable register
`*ESR?`	EVENT STATUS QUERY, queries the contents of the event status register.

Device-specific commands

Hierarchy: Device-specific commands are of hierarchical structure (see Fig. 3.5-1). The different levels are represented by combined headers. Headers of the highest level (root level) have only one key word. This key word denotes a complete command system.

Example: `SENSe` This key word denotes the command system `SENSe`.

For commands of lower levels, the complete path has to be specified, starting on the left with the highest level, the individual key words being separated by a colon ":".

Example: `SENSe:FREQuency:SPAN:LINK STARt`

This command lies in the fourth level of the SENSe system. It determines which parameter remains unchanged when the span is changed. If LINK is set to STARt, the values of CENTer and STOP are adjusted when the span is changed.

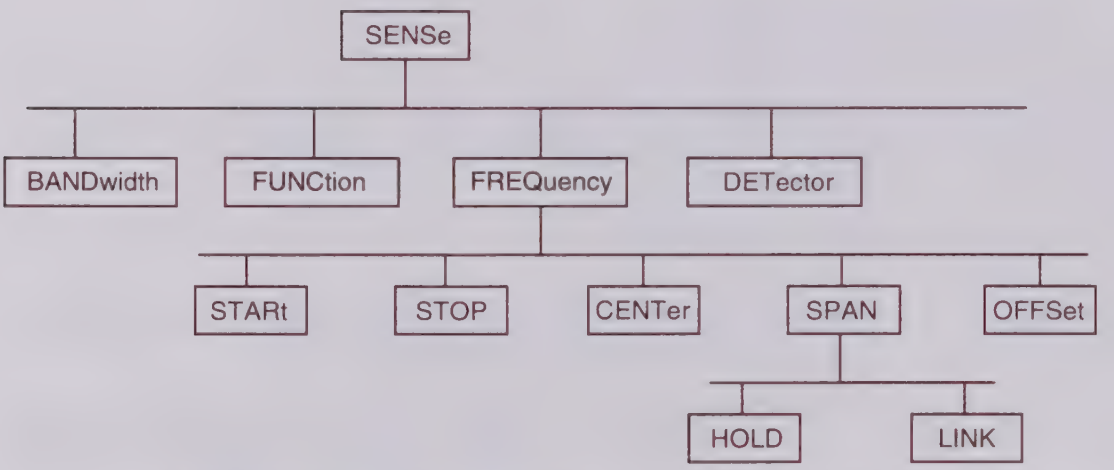

Fig. 3.5-1 Tree structure the SCPI command systems using the SENSe system by way of example

Some key words occur in several levels within one command system. Their effect depends on the structure of the command, that is to say, at which position in the header of a command they are inserted.

Example: `SOURce:FM:POLarity NORMal`
This command contains key word POLarity in the third command level. It defines the polarity between modulator and modulation signal.

`SOURce:FM:EXTernal:POLarity NORMal`
This command contains key word POLarity in the fourth command level. It defines the polarity between modulation voltage and the resulting direction of the modulation only for the external signal source indicated.

Optional key words: Some command systems permit certain key words to be optionally inserted into the header or omitted. These key words are marked by square brackets in the description. The full command length must be recognized by the instrument for reasons of compatibility with the SCPI standard. Some commands are considerably shortened by these optional key words.

Example: `[SENSe]:BANDwidth[:RESolution]:AUTO`
This command couples the resolution bandwidth of the instrument to other parameters. The following command has the same effect:
BANDwidth`:AUTO`

Note: *An optional key word must not be omitted if its effect is specified in detail by a numeric suffix.*

Long and short form: The key words feature a long form and a short form. Either the short form or the long form can be entered, other abbreviations are not permissible.

Beispiel: `STATus:QUEStionable:ENABle 1= STAT:QUES:ENAB 1`

Note: *The short form is marked by upper-case letters, the long form corresponds to the complete word. Upper-case and lower-case notation only serve the above purpose, the instrument itself does not make any difference between upper-case and lower-case letters.*

Parameter: The parameter must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma ",". A few queries permit the parameters MINimum, MAXimum and DEFault to be entered. For a description of the types of parameter, refer to Section 3.5.5.

Example: `SENSe:FREQuency:STOP? MAXimum` Response: 3.5E9
This query requests the maximal value for the stop frequency.

Numeric suffix: If a device features several functions or features of the same kind, e.g. inputs, the desired function can be selected by a suffix added to the command. Entries without suffix are interpreted like entries with the suffix 1.

Example:. `SYSTem:COMMunicate:SERial2:BAUD 9600`
This command sets the baudrate of the second serial interface.

3.5.3 Structure of a Command Line

A command line may consist of one or several commands. It is terminated by a <New Line>, a <New Line> with EOI or an EOI together with the last data byte. Quick BASIC automatically produces an EOI together with the last data byte.

Several commands in a command line are separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:
```
CALL IBWRT(analyzer%, "SENSe:FREQuency:CENTer 100MHz;:INPut:ATTenuation 10")
```

This command line contains two commands. The first command is part of the SENSe system and is used to specify the center frequency of the analyzer. The second command is part of the INPut system and sets the attenuation of the input signal.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels (see also Fig. 3.5-1). The colon following the semicolon must be omitted in this case.

Example:
```
CALL IBWRT(analyzer%, "SENSe:FREQuency:STARt 1E6;:SENSe:FREQuency:STOP 1E9")
```

This command line is represented in its full length and contains two commands separated from each other by the semicolon. Both commands are part of the SENSe command system, subsystem FREQuency, i.e. they have two common levels.
When abbreviating the command line, the second command begins with the level below SENSe:FREQuency. The colon after the semicolon is omitted.

The abbreviated form of the command line reads as follows:

```
CALL IBWRT(analyzer%,  "SENSe:FREQuency:STARt 1E6;STOP 1E9")
```

However, a new command line always begins with the complete path.

Example:
```
CALL IBWRT(analyzer%,  "SENSe:FREQuency:STARt 1E6")
CALL IBWRT(analyzer%,  "SENSe:FREQuency:STOP 1E9")
```

3.5.4 Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

1 The requested parameter is transmitted without header.
Example: `INPut:COUPling?` Response: `DC`

2. Maximum values, minimum values and all further quantities, which are requested via a special text parameter are returned as numerical values.
Example: `SENSe:FREQuency:STOP? MAX` Response: `3.5E9`

3. Numerical values are output without a unit. Physical quantities are referred to the basic units or to the units set using the Unit command.
Example: `SENSe:FREQuency:CENTer?` Response: `1E6` for 1 MHz

4. Truth values <Boolean values> are returned as 0 (for OFF) and 1 (for ON).
Example: `SENSe:BANDwidth:AUTO?` Response: `1` for ON

5. Text (character data) is returned in a short form (see also Section 3.5.5).
Example: `SYSTem:COMMunicate:SERial:CONTrol:RTS?` Response(for standard): `STAN`

3.5.5 Parameters

Most commands require a parameter to be specified. The parameters must be separated from the header by a "white space". Permissible parameters are numerical values, Boolean parameters, text, character strings and block data. The type of parameter required for the respective command and the permissible range of values are specified in the command description (see Section 3.6).

Numerical values

Numerical values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not permissible. In the case of physical quantities, the unit can be entered. Permissible unit prefixes are G (giga), MA (mega), MOHM and MHZ are also permissible), K (kilo), M (milli), U (micro) and N (nano). It the unit is missing, the basic unit is used.

Example:
`SENSe:FREQuency:STOP 1.5GHz = SENSe:FREQuency:STOP 1.5E9`

Special numerical

The texts MINimum, MAXimum, DEFault, UP and DOWN are interpreted as valuesspecial numerical values.

In the case of a query, the numerical value is provided.

Example: Setting command: `SENSe:FREQuency:STOP MAXimum`
Query: `SENSe:FREQuency:STOP?` Response: `3.5E9`

MIN/MAX — MINimum and MAXimum denote the minimum and maximum value.

DEF — DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command

UP/DOWN — UP, DOWN increases or reduces the numerical value by one step. The step width can be specified via an allocated step command (see annex C, List of Commands) for each parameter which can be set via UP, DOWN.

INF/NINF — INFinity, Negative INFinity (NINF) Negative INFinity (NINF) represent the numerical values -9.9E37 or 9.9E37, respectively. INF and NINF are only sent as device reponses.

NAN — Not A Number (NAN) represents the value 9.91E37. NAN is only sent as device response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Boolean Parameters

Boolean parameters represent two states. The ON state (logically true) is represented by ON or a numerical value unequal to 0. The OFF state (logically untrue) is represented by OFF or the numerical value 0. 0 or 1 is provided in a query.

Example: Setting command: `DISPlay:WINDow:STATe ON`
Query: `DISPlay:WINDow:STATe?` Response: `1`

Text

Text parameters observe the syntactic rules for key words, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example: Setting command: `INPut:COUPling GROund`
Query: `INPut:COUPling?` Response `GRO`

Strings

Strings must always be entered in quotation marks (' or ").

Example: `SYSTem:LANGuage "SCPI"` or
`SYSTem:LANGuage 'SCPI'`

Block data

Block data are a transmission format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example: `HEADer:HEADer #45168xxxxxxxx`

ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all End or other control signs are ignored until all bytes are transmitted..

3.5.6 Overview of Syntax Elements

The following survey offers an overview of the syntax elements.

:	The colon separates the key words of a command. In a command line the colon after the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*	The asterix marks a common command.
"	Quotation marks introduce a string and terminate it.
#	ASCII character # introduces block data.
	A "white space (ASCII-Code 0 to 9, 11 to 32 decimal, e.g.blank) separates header and parameter.

3.6 Description of Commands

3.6.1 Notation

In the following sections, all commands implemented in the instrument are first listed in tables and then described in detail, separated according to the command system. The notation corresponds to the one of the SCPI standards to a large extent. The SCPI conformity information can be taken from the individual description of the commands.

Table of Commands

Command: In the command column, the table provides an overview of the commands and their hierarchical arrangement (see indentations).

Parameter: The parameter column indicates the requested parameters together with their specified range.

Unit: The unit column indicates the basic unit of the physical parameters.

Remark: In the remark column an indication is made on:
- whether the command does not have a query form,
- whether the command has only one query form
- whether this command is implemented only with a certain option of the instrument

Indentations

The different levels of the SCPI command hierarchy are represented in the table by means of indentations to the right. The lower the level is, the farther the indentation to the right is. Please observe that the complete notation of the command always includes the higher levels as well.

Example: `SENSe:FREQuency:CENTer` is represented in the table as follows:

`SENSe`	first level
`:FREQuency`	second level
`:CENTer`	third level

In the individual description, the complete notation of the command is given. An example for each command is written out at the end of the individual description.

Upper/lower case notation

Upper/lower case letters serve to mark the long or short form of the key words of a command in the description (see Section 3.5.2). The instrument itself does not distinguish between upper and lower case letters.

Special characters

| A selection of key words with an identical effect exists for several commands. These key words are indicated in the same line, they are separated by a vertical stroke. Only one of these key words has to be indicated in the header of the command. The effect of the command is independent of which of the key words is indicated.

Example: `SENSe:FREQuency:CW|:FIXed`

The two following commands of identical meaning can be formed. They set the frequency of the constantly frequent signal to 1 kHz:

`SENSe:FREQuency:CW 1E3` = `SENSe:FREQuency:FIXed 1E3`

A vertical stroke in indicating the parameters marks alternative possibilities in the sense of "or". The effect of the command is different, depending on which parameter is entered.

Example: Selection of the parameters for the command

`INPut:COUPling AC | DC`

If parameter AC is selected, only the AC content is fed through, in the case of DC, the DC as well as the AC content.

[ ] Key words in square brackets can be omitted when composing the header (cf. Section 3.5.2, Optional Keywords). The full command length must be accepted by the instrument for reasons of compatibility with the SCPI standards.
Parameters in square brackets can optionally be incorporated in the command or omitted as well.

{ } Parameters in braces can optionally be incorporated in the command either not at all, once or several times.

Description of parameters Due to the standardization, the parameter section of SCPI commands consists always of the same syntactical elements. SCPI has specified a series of definitions therefore, which are used in the tables of commands. In the tables, these established definitions are indicated in angled brackets (<...>) and will be briefly explained in the following (see also Section 3.5.5, "Parameters").

<Boolean> This indication refers to parameters which can adopt two states, "on" and "off". The "off" state may either be indicated by the keyword **OFF** or by the numeric value 0, the "on" state is indicated by **ON** or any numeric value other than zero. Parameter queries are always returned the numeric value 0 or 1.

<numeric_value>

<num> These indications mark parameters which may be entered as numeric values or be set using specific keywords (character data).

The keywords given below are permitted:

MINimum This keyword sets the parameter to the smallest possible value.

MAXimum This keyword sets the parameter to the largest possible value.

DEFault This keyword is used to reset the parameter to its default value.

UP This keyword increments the parameter value.

DOWN This keyword decrements the parameter.

The numeric values associated to MAXimum/MINimum/DEFault can be queried by adding the corresponding keywords to the command. They must be entered following the quotation mark.

Example: `SENSe:FREQuency:CENTer? MAXimum`

returns the maximum possible numeric value of the center frequency as result.

<arbitrary block program data>

This keyword is provided for commands the parameters of which consist of a binary data block.

3.6.2 Common Commands

The common commands are taken from the IEEE 488.2 (IEC 625-2) standard. Same commands have the same effect on different devices. The headers of these commands consist of an asterisk "*" followed by three letters. Many common commands refer to the status reporting system which is described in detail in Section 3.8.

Command	Designation	Parameter	Remark
*CAL?	Calibration Query		query only
*CLS	Clear Status		no query
*ESE	Event Status Enable	0 to 255	
*ESR?	Standard Event Status Query	0 to 255	query only
*IDN?	Identification Query	<string>	query only
*IST?	Individual Status Query	0 to 255	query only
*OPC	Operation Complete		
*OPT?	Option Identification Query		query only
*PCB	Pass Control Back	0 to 30	no query
*PRE	Parallel Poll Register Enable	0 to 255	
*PSC	Power On Status Clear	0 | 1	
*RST	Reset		no query
*SRE	Service Request Enable	0 to 255	
*STB?	Status Byte Query		query only
*TRG	Trigger		no query
*TST?	Self Test Query		query only
*WAI	Wait to continue		no query

***CAL?**

CALIBRATION QUERY triggers a calibration of the instrument and subsequently query the calibration status. Any responses > 0 indicate errors.

***CLS**

CLEAR STATUS sets the status byte (STB), the standard event register (ESR) and the EVENt-part of the QUEStionable and the OPERation register to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

***ESE 0 to 255**

EVENT STATUS ENABLE sets the event status enable register to the value indicated. Query *ESE? returns the contents of the event status enable register in decimal form.

***ESR?**

STANDARD EVENT STATUS QUERY returns the contents of the event status register in decimal form (0 to 255) and subsequently sets the register to zero.

***IDN?**

IDENTIFICATION QUERY queries the instrument identification.

The device response is for example: "Rohde&Schwarz, FSE, 123456, 1.03"

FSE = Device
123456 = serial number
1.03 = Firmware versions number

***IST?**

INDIVIDUAL STATUS QUERY returns the contents of the IST flag in decimal form (0 | 1). The IST flag is the status bit which is sent during a parallel poll (cf. Section 3.8.3.2).

***OPC**

OPERATION COMPLETE sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request (cf. Section 3.7).

***OPC?**

OPERATION COMPLETE QUERY writes message "1" into the output buffer as soon as all preceding commands have been executed (cf. Section 3.7).

***OPT?**

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The options are separated from each other by means of commas.

Position	Option	
1	FSE-B3	TV Demodulator
2	FSE-B4	Low Phase Noise & OCXO
3	FSE-B5	FFT-Filter
4		reserved
5	FSE-B7	Vector Signal Analysis
6	FSE-B8	Tracking Generator 3.5 GHz
7	FSE-B9	Tracking Generator 3.5 GHz with I/Q modulator
8	FSE-B10	Tracking Generator 7 GHz
9	FSE-B11	Tracking Generator 7 GHz with I/Q modulator
10	FSE-B12	Output Attenuator for Tracking Generator
11		reserved
12		reserved

Example: `0, FSE-B4, 0, 0, FSE-B7, 0, 0, 0, FSE-B11, FSE-B12, 0, 0`

***PCB 0 to 30**

PASS CONTROL BACK indicates the controller address which the IEC-bus control is to be returned to after termination of the triggered action.

***PRE 0 to 255**

PARALLEL POLL REGISTER ENABLE sets parallel poll enable register to the value indicated. Query *PRE? returns the contents of the parallel poll enable register in decimal form.

***PSC 0 | 1**

POWER ON STATUS CLEAR determines whether the contents of the ENABle registers is maintained or reset in switching on.

*PSC = 0 causes the contents of the status registers to be maintained. Thus a service request can be triggered in switching on in the case of a corresponding configuration of status registers ESE and SRE.

*PSC ≠ 0 resets the registers.

Query *PSC? reads out the contents of the power-on-status-clear flag. The response can be 0 or 1.

***RST**

RESET sets the instrument to a defined default status. The command essentially corresponds to pressing the [PRESET] key. The default setting is indicated in the description of the commands.

***SRE 0 to 255**

SERVICE REQUEST ENABLE sets the service request enable register to the value indicated. Bit 6 (MSS mask bit) remains 0. This command determines under which conditions a service request is triggered. Query *SRE? reads the contents of the service request enable register in decimal form. Bit 6 is always 0.

***STB?**

READ STATUS BYTE QUERY reads out the contents of the status byte in decimal form.

***TRG**

TRIGGER triggers all actions waiting for a trigger event (cf. Section "TRIGger subsystem", as well).

***TST?**

SELF TEST QUERY triggers all selftests of the instrument and outputs an error code in decimal form.

***WAI**

WAIT-to-CONTINUE only permits the servicing of the subsequent commands after all preceding commands have been executed and all signals have settled (cf. Section 3.7 and "*OPC" as well).

3.6.3 ABORt Subsystem

The ABORt subsystem contains the commands for aborting triggered actions. An action can be triggered again immediately after being aborted. All commands trigger events which is why they are not assigned any *RST value.

COMMAND	PARAMETERS	UNIT	COMMENT
ABORt	--	--	no query

ABORt

This command aborts a current measurement and resets the trigger system.

Syntax: ABORt

Example: "ABOR;INIT:IMM"

Features: *RST value: 0
SCPI: conforming

3.6.4 CALCulate Subsystem

The CALCulate subsystem contains commands for converting instrument data, transforming and carrying out corrections. These functions are carried out subsequent to data acquistion, i.e., following the SENSe subsystem.

In the split-screen representation, a distinction is made between CALCulate1 and CALCulate2:

CALCulate1 ≙ screen A;

CALCulate2 ≙ screen B

3.6.4.1 CALCulate:DELTamarker Subsystem

The CALCulate:DELTamarker subsystem checks the delta-marker functions in the instrument.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:DELTamarker<1 to 4>			
[:STATe]	<Boolean>	--	
:MODE	ABSolute|RELative		
:AOFF			no query
:TRACe	<numeric_value>	--	
:X	<numeric_value>	HZ | S | SYM	
:RELative?	--	--	query only
:Y?	--	--	query only
:MAXimum			
[:PEAK]	--	--	no query
:APEak	--	--	no query (option vector analysis)
:NEXT	--	--	no query
:RIGHt	--	--	no query
:LEFT	--	--	no query
:MINimum			
[:PEAK]	--	--	no query
:NEXT	--	--	no query
:RIGHt	--	--	no query
:LEFT	--	--	no query
:FUNCtion			
:FIXed			
[:STATe]	<Boolean>		
:RPOint			
:Y	<numeric_value>	DBM	
:OFFSet	<numeric_value>	DB	
:X	<numeric_value>	HZ |S | SYM	
:PNOise			
[:STATe]	<Boolean>		
:RESult?	--	--	query only
:STEP			
[:INCRement]	<numeric_value>	HZ |S | SYM	
:AUTO	<Boolean>	--	

CALCulate<1|2>:DELTamarker<1 to 4>[:STATe]

This command switches on or off the selected delta marker. If no indication is made, delta marker 1 is selected automatically.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>[:STATe] ON | OFF

Example: "CALC:DELT3 ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:DELTamarker<1 to 4>:MODE

This command switches over between relative and absolute input of frequency of the delta marker.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:MODE ABSolute | RELative

Example: "CALC:DELT:MODE ABS"

Features: *RST value: REL
SCPI: device-specific

In the RELative mode, the frequency of the delta marker is programmed relative to the reference marker. In the ABSolute mode, the frequency is defined by the absolute values.

CALCulate<1|2>:DELTamarker<1 to 4>:AOFF

This command switches off all active delta markers.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:AOFF

Example: "CALC:DELT:AOFF"

Features: *RST value: -
SCPI: device-specific

CALCulate<1|2>:DELTamarker<1 to 4>:TRACe

This command assigns the selected delta marker to the indicated measuring curve.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:TRACe <numeric value>
<numeric value> ::= 1 to 4

Example: "CALC:DELT3:TRAC 2"

Features: *RST value: -
SCPI: device-specific

CALCulate<1|2>:DELTamarker<1 to 4>:X

This command positions the selected delta marker to the indicated frequency (span > 0) or time (span = 0). The query always returns the absolute frequency or time.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:X <numeric value>
<numeric value> ::= 0 to MAX (frequency) | MAX (sweep time) | MAX (symbols)

Example: "CALC:DELT:X 10.7MHz"

Features: *RST value: -
SCPI: device-specific

The SYM unit is only valid in conjunction with option FSE-B7, Vector Signal Analysis. When used as a query, this command always returns the absolute value of the frequency or time.

CALCulate<1|2>:DELTamarker<1 to 4>:X:RELative?

This command queries the frequency (span > 0) or time (span = 0) of the selected delta marker relative to the reference marker.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:X:RELative?

Example: "CALC:DELT:X:REL?"

Features: *RST value: -
SCPI: device-specific

CALCulate<1|2>:DELTamarker<1 to 4>:Y?

This command queries the value of the selected marker.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:Y?

Example: "CALC:DELT:Y?"

Features: *RST value: -
SCPI: device-specific

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum[:PEAK]

This command positions the delta marker to the current maximum value in the trace memory.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum[:PEAK]

Example: "CALC:DELT:MAX"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:APEak

This command positions the delta marker to the maximum absolute value of the trace.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:APEak

Example: "CALC:DELT:MAX:APE"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:NEXT

This command positions the delta marker to the next smaller maximum value in the trace memory.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:NEXT

Example: "CALC:DELT:MAX:NEXT"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:RIGHt

This command positions the delta marker to the next smaller maximum value to the right of the current value (i.e., in ascending X direction) in the trace memory.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:RIGHt

Example: "CALC:DELT:MAX:RIGH"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:LEFT

This command positions the delta marker to the next smaller maximum value to the left of the current value (i.e., in descending X direction) in the trace memory.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:LEFT

Example: `"CALC:DELT:MAX:LEFT"`

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum[:PEAK]

This command positions the delta marker to the current minimum value in the trace memory.

Syntax: <1|2>:DELTamarker<1 to 4>:MINimum[:PEAK]

Example: `"CALC:DELT:MIN"`

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:NEXT

This command positions the delta marker to the next higher minimum value in the trace memory.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:NEXT

Example: `"CALC:DELT:MIN:NEXT"`

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:RIGHt

This command positions the delta marker to the next higher minimum value to the right of the current value (ie in ascending X direction).

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:RIGHt

Example: `"CALC:DELT:MIN:RIGH"`

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:LEFT

This command positions the delta marker to the next higher minimum value to the left of the current value (ie in descending X direction).

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:LEFT

Example: `"CALC:DELT:MIN:LEFT"`

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed[:STATe]

This command switches the relative measurement to a fixed reference value on or off.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed[:STATe] ON | OFF

Example: "CALC:DELT:FUNC:FIX ON"

Features: *RST value: OFF
SCPI: device-specific.

The reference value is independent of the current trace.

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y

This command defines a new fixed reference value for the relative measurement.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y
<numeric_value>

Example: "CALC:DELT:FUNC:FIX:RPO:X -10dBm"

Features: *RST value: - (FUNction:FIXed[:STATe] is set to OFF)
SCPI: device-specific

The reference value is independent of the current trace.

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y:OFFSet

This command defines an additional level offset for the relative measurement.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:Y:OFFSet
<numeric_value>

Example: "CALC:DELT:FUNC:FIX:RPO:Y:OFFS 10dB"

Features: *RST value: 0 dB
SCPI: device-specific

The level offset is included in the output of the level value.

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:X

This command defines the new fixed reference frequency, time or symbols for the relative measurement.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed:RPOint:X
<numeric_value>

Example: "CALC:DELT:FUNC:FIX:RPO:X 10.7MHz"

Features: *RST value: - (FUNction:FIXed[:STATe] is set to OFF)
SCPI: device-specific

The reference value is independent of the current trace. With span = 0, the reference time, otherwise the reference frequency is defined.

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise[:STATe]

This command switches the measurement of the phase noise on or off.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise[:STATe] ON | OFF

Example: "CALC:DELT:FUNC:PNO ON"

Features: *RST value: OFF
SCPI: device-specific

When the phase noise is measured, the correction values for the bandwidth and the log amplifier are automatically considered. The measurement uses the reference values defined by FUNCtion:FIXed:RPOint:X or Y.

CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise:RESult?

This command queries the result of the phase noise measurement.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise:RESult?

Example: "CALC:DELT:FUNC:PNO:RES?"

Features: *RST value: -
SCPI: device-specific

This command is only a query which is why it is not assigned an *RST value.

CALCulate<1|2>:DELTamarker<1 to 4>:STEP[:INCRement]

This command defines the delta marker step width.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:STEP[:INCRement] <numeric_value>

Example: "CALC:DELT:STEP 10kHz" (frequency domain)
"CALC:DELT:STEP 5ms" (time domain)
"CALC:DELT:STEP 20SYM" (time domain)

Features: *RST value: - (STEP is set to AUTO)
SCPI: device-specific

CALCulate<1|2>:DELTamarker<1 to 4>:STEP:AUTO

This command switches the automatic adaptation of the marker step width on or off.

Syntax: CALCulate<1|2>:DELTamarker<1 to 4>:STEP:AUTO ON | OFF

Example: "CALC:DELT:STEP:AUTO OFF"

Features: *RST value: ON
SCPI: device-specific

With AUTO ON, the step width is 10% of the span.

3.6.4.2 CALCulate:DLINe Subsystem

The CALCulate:DLINe subsystem checks the display lines in the instrument, i.e., the level, frequency and time lines (depending on the X-axis) as well as threshold and reference lines.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:DLINe<1|2>	<numeric_value>	DBM | DB | DEG | RAD | S | HZ | PCT	
:STATe	<Boolean>		
:THReshold	<numeric_value>	DBM | DB | DEG | RAD | S | HZ | PCT	
:STATe	<Boolean>		
:RLINe	<numeric_value>	DBM | DB | DEG | RAD | S | HZ | PCT	
:STATe	<Boolean>		
:FLINe<1|2>	<numeric_value>	HZ	
:STATe	<Boolean>		
:TLINe<1|2>	<numeric_value>	S | SYM	
:STATe	<Boolean>		

CALCulate<1|2>:DLINe<1|2>

This command defines the position of the display line.

Syntax: CALCulate:DLINe<1|2> <numeric_value>
<numeric_value>::= MINimum to MAXimum (depending on current unit)

Example: "CALC:DLIN -20dBm"

Features: *RST value: - (STATe to OFF)
SCPI: device-specific

The display lines mark the given level in the display.

The units DEG, RAD, S, HZ, and PCT are only valid in conjunction with option Vector Signal Analysis, FSE-B7.

CALCulate<1|2>:DLINe<1|2>:STATe

This command switches the display line on or off.

Syntax: CALCulate:DLINe<1|2>:STATe ON | OFF

Example: "CALC:DLIN2:STAT OFF"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:THReshold

This command defines the position of the thresholds.

Syntax: CALCulate:THReshold <numeric_value>
<numeric_value>::= MINimum to MAXimum (depending on current unit)

Example: "CALC:THR -82dBm"

Features: *RST value: - (STATe to OFF)
SCPI: device-specific

For marker scan functions MAX PEAK, NEXT PEAK etc., the threshold serves as the lowest limit for maximum or minimum search. The units DEG, RAD, S, HZ, and PCT are only valid in conjunction with option Vector Signal Analysis, FSE-B7.

CALCulate<1|2>:THReshold:STATe

This command switches the threshold on or off.

Syntax: CALCulate:THReshold ON | OFF

Example: "CALC:THR:STAT ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:RLINe

This command defines the position of the reference line.

Syntax: CALCulate:RLINe <numeric_value>
<numeric_value>::= MINimum to MAXimum (depending on the current unit)

Example: "CALC:RLIN -10dBm"

Features: *RST value: - (STATe to OFF)
SCPI: device-specific

The reference line serves as a reference for the arithmetic operation of traces.

The units DEG, RAD, S, HZ, and PCT are only valid in connection with option FSE-B7, Vector Signal Analysis.

CALCulate<1|2>:RLINe:STATe

This command switches the reference line on or off.

Syntax: CALCulate:RLINe:STATe ON | OFF

Example: "CALC:RLIN:STAT ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:FLINe<1|2>

This command defines the position of the frequency lines.

Syntax: CALCulate:FLINe<1|2> <numeric_value>
<numeric_value>::= 0 GHz to f_{max}

Example: "CALC:FLIN2 120MHz"

Features: *RST value: - (STATe to OFF)
SCPI: device-specific

The frequency lines mark the given frequencies in the display. Frequency lines are only valid for a SPAN >0.

CALCulate<1|2>:FLINe<1|2>:STATe

This command switches the frequency line on or off.

Syntax: CALCulate:FLINe<1|2>:STATe ON | OFF

Example: "CALC:FLIN2:STAT ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:TLINe<1|2>

This command defines the position of the time lines.

Syntax: CALCulate:TLINe<1|2> <numeric_value>
<numeric_value>::= 0 to 1000s

Example: "CALC:TLIN 10ms"

Features: *RST value: - (STATe to OFF)
SCPI: device-specific

The time lines mark the given times in the display. Time lines are only valid for a SPAN = 0.

CALCulate<1|2>:TLINe<1|2>:STATe

This command switches the time line on or off.

Syntax: CALCulate:TLINe<1|2>:STATe ON | OFF

Example: "CALC:TLIN2:STAT ON"

Features: *RST value: OFF
SCPI: device-specific

3.6.4.3 CALCulate:FEED Subsystem

The CALCulate:FEED subsystem selects the measured data in operating mode vector signal analysis. This sub system is only valid in connection with option FSE-B7, Vector Signal Analysis.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2> :FEED	<string>		Vector Signal Analysis no query

CALCulate<1|2>:FEED

This command selects the measured data that are to be displayed

Syntax: CALCulate<1|2>:FEED <string>
<string>::= 'XTIM:DDEM:MEAS' |
'XTIM:DDEM:REF' |
'XTIM:DDEM:ERR:MPH' |
'XTIM:DDEM:ERR:VECT' |
'XTIM:DDEM:SYMB' |
'XTIM:AM' |
'XTIM:FM' |
'XTIM:PM' |
'XTIM:AMSummary' |
'XTIM:FMSummary' |
'XTIM:PMSummary' |
'TCAP'

Example: "CALC:FEED 'XTIM:DDEM:SYMB'"

Features: *RST value: 'XTIM:DDEM:MEAS'
SCPI: conforming

The string parameters have the following meaning:

'XTIM:DDEM:MEAS'	Test signal (filtered, synchronized to symbol clock)
'XTIM:DDEM:REF'	Reference signal (internally generated from demodulated test signal)
'XTIM:DDEM:ERR:MPH'	Error signal (magnitude and phase error)
'XTIM:DDEM:ERR:VECT'	Vector error signal
'XTIM:DDEM:SYMB'	Symbol table (demodulated bits and table with modulation errors)
'XTIM:AM'	Demodulated AM signal (analog demodulation)
'XTIM:FM'	Demodulated FM signal (analog demodulation)
'XTIM:PM'	Demodulated PM signal (analog demodulation)
'XTIM:AMSummary'	AM-Summary Marker (analog demodulation)
'XTIM:FMSummary'	FM-Summary Marker (analog demodulation)
'XTIM:PMSummary'	PM-Summary Marker (analog demodulation)
'TCAP'	Test signal in capture buffer

This command is only valid in conjunction with option Vector Signal Analysis, FSE-B7.

3.6.4.4 CALCulate:FORMat Subsystem

The CALCulate:FORMat subsystem determines further processing and conversion of measured data in operating mode vector signal analysis.
This sub system is only valid in connection with option FSE-B7, Vector Signal Analysis.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2> :FORMat	MAGNitude | PHASe | UPHase | RIMag | FREQuency | IEYE | QEYE | TEYE | FEYE | COMP | CONS		Vector Signal Analysis
:FSK :DEViation :REFerence	<numeric_value>	HZ	Vector Signal Analysis

CALCulate<1|2>:FORMat

This command defines the display of the traces.

Syntax: CALCulate<1|2>:FORMat MAGNitude | PHASe | UPHase | RIMag | FREQuency | IEYE | QEYE | TEYE | FEYE | COMP | CONS

Example: "CALC:FORM CONS"

Features: *RST value: MAGNitude
SCPI: conforming

The parameters have the following meaning:

MAGNitude	Display of the magnitude in the time domain
PHASe | UPHase	Display of the phase in the time domain with or without ("unwrapped") limitation to ±180°
RIMag	Display of the time characteristic of inphase and quadrature component
FREQuency	Display of the frequency response in the time domain
IEYE | QEYE	Eye diagram of the inphase or quadrature component
TEYE	Display of the trellis diagram
FEYE	Eye diagram of FSK modulation
COMP	Display of the polar vector diagram (complex)
CONS	Display of the polar vector diagaram (constellation)

This command is only valid in conjunction with option Vector Signal Analysis, FSE-B7.

CALCulate<1|2>:FSK:DEViation:REFerence

This command defines the reference value of the frequency deviation for FSK modulation.

Syntax: CALCulate<1|2>:FSK:DEViation:REFerence <numeric_value>

Example: "CALC:FSK:DEV:REF 20kHz"

Features: *RST value: -
SCPI: device-specific

This command is only valid in conjunction with option Vector Signal Analysis, FSE-B7.

3.6.4.5 CALCulate:LIMit Subsystem

The CALCulate:LIMit subsystem comprises the limit lines and the corresponding limit checks. Limit lines can be defined as upper and lower limit lines. The individual values of the limit lines correspond to the values of the X-axis (CONTrol) which have to have the same number.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate			
:LIMit<1 to 8>			
:STATe	<Boolean>	--	
:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ | DEG | RAD | S | HZ | PCT | UNITLESS		
:CONTrol			
[:DATA]	<numeric_value>,<numeric_value>..	HZ | S | SYM	
:DOMain	FREQuency | TIME		
:OFFSet	<numeric_value>	HZ | S | SYM	
:MODE	RELative | ABSolute		
:UNIT			
[:TIME]	S | SYM		
:SHIFt	<numeric_value>	HZ | S | SYM	Vector Signal Analysis
:UPPer			
[:DATA]	<numeric_value>,<numeric_value>..	DBM | DB | DEG | RAD | S | HZ | PCT	
:STATe	<Boolean>	--	
:OFFSet	<numeric_value>	DB | DEG | RAD | S | HZ | PCT	
:MARGin	<numeric_value>	DB| DEG | RAD | S | HZ | PCT	
:MODE	RELative | ABSolute	--	
:SHIFt	<numeric_value>	DB | DEG | RAD| S | HZ | PCT	
:LOWer			
[:DATA]	<numeric_value>,<numeric_value>..	DBM | DB | DEG | RAD | S | HZ | PCT	
:STATe	<Boolean>	--	
:OFFSet	<numeric_value>	DB| DEG | RAD | S | HZ | PCT	
:MARGin	<numeric_value>	DB| DEG | RAD | S | HZ | PCT	
:MODE	RELative | ABSolute	--	
:SHIFt	<numeric_value>	DB | DEG | RAD | S | HZ | PCT	
:FAIL?			query only
:CLEar		--	
[:IMMediate]	--	--	no query
:COMMent			
:COPY	<string>		
:NAME	1 to 8 | < name>		
:DELete	<string>		
:BURSt	--		Option FSE-K11 or K10
:PTEMplate?			
:POWer?	--		

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate			
:LIMit<1 to 8>		--	
:SPECtrum	--		Option FSE-K11 or FSE-K10
:MODulation?	ARFCn | TXBand | RXBand | COMBined | DCSRx1800		
:FAILs?	ARFCn | TXBand | RXBand | COMBined | DCSRx1800		
:EXCeptions?	ARFCn | TXBand | RXBand | COMBined | DCSRx1800		
:SWITching?	ARFCn | TXBand | RXBand | COMBined		Option FSE-K11 or FSE-K10
:FAILs?	ARFCn | TXBand | RXBand | COMBined		
:SPURious?	TXBand | OTXBand | RXBand | IDLeband		Option FSE-K11 or FSE-K10
:FAILs?	TXBand | OTXBand | RXBand | IDLeband		
:MARGin	<numeric_value>	DB	
:ACPower			
[:STATe]	<Boolean>		
:ACHannel	<numeric_value>, <numeric_value>	DB; DB	
:STATe	<Boolean>		
:RESult?	--		query only
:ALTernate<1|2>	<numeric_value>, <numeric_value>	DB; DB	
:STATe	<Boolean>		
:RESult?	--		query only

CALCulate<1|2>:LIMit<1 to 8>:STATe

This command switches the limit check for the selected limit line on or off.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:STATe ON | OFF

Example: `"CALC:LIM:STAT ON"`

Features: *RST value: OFF
SCPI: conforming

The result of the limit check can be queried with `CALCulate:LIMit:FAIL?`.

CALCulate<1|2>:LIMit<1 to 8>:UNIT

This command defines the unit of the selected limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:UNIT DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_MHZ | DBMV_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ |DEG | RAD | S | HZ | PCT | UNITLESS

Example: `"CALC:LIM:UNIT DBUV"`

Features: *RST value: DBM
SCPI: device-specific

DBUV_MHZ and DBUA_MHZ denote the units DBUV/MHZ or DBUA/MHZ. The units DEG, RAD, S, HZ, PCT are available in the signal analysis mode only.
Upon selection of the unit DB the limit line is automatically switched to the relative mode. For units different from DB the limit line is automatically switched to the absolute mode.

CALCulate<1|2>:LIMit<1 to 8>:CONTrol[:DATA]

This command defines the X-axis values (frequencies or times) of the upper or lower limit lines.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:CONTrol[:DATA]
<numeric_value>,<numeric_value>..

Example: "CALC:LIM:CONT 1MHz,30MHz,300MHz,1GHz"

Features: *RST value: - (LIMit:STATe is set to OFF)
SCPI: conforming

The number of values for the CONTrol axis and the corresponding UPPer- and/or LOWer limit lines have to be identical.

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:DOMain

This command defines the X-axis in the frequency or time domain.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:CONTrol:DOMain FREQuency | TIME

Example: "CALC:LIM:CONT:DOM TIME"

Features: *RST value: FREQuency
SCPI: device-specific

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:OFFSet

This command defines an offset for the X-axis value of the selected relative limit line in the frequency or time domain.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:CONTrol:OFFset <numeric_value>

Example: "CALC:LIM:CONT:OFFS 100us"

Features: *RST value: 0
SCPI: device-specific

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:MODE

This command selects the relative or absolute scaling for the X-axis of the selected limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:CONTrol:MODE RELative | ABSolute

Example: "CALC:LIM:CONT:MODE REL"

Features: *RST value: ABSolute
SCPI: device-specific

Upon selection of RELative, the unit is switched to DB.

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:UNIT[:TIME]

This command defines the unit of the x-axis scaling of limit lines.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:CONTrol:UNIT[:TIME] S | SYM

Example: "CALC:LIM:CONT:UNIT SYM"

Features: *RST value: S
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:LIMit<1 to 8>:CONTrol:SHIFt

This command shifts a limit line which has been specified for relative frequencies or times (X-axis).

Syntax: CALCulate<1|2>:LIMit<1 to 8>:CONTrol:SHIFt <numeric_value>

Example: "CALC:LIM:CONT:SHIF 50kHz"

Features: *RST value: --
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:LIMit<1 to 8>:UPPer[:DATA]

This command defines the values for the upper limit lines.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:UPPer[:DATA]
<numeric_value>,<numeric_value>..

Example: "CALC:LIM:UPP -10,0,0,-10"

Features: *RST value: - (LIMit:STATe is set to OFF)
SCPI: conforming

The number of values for the CONTrol axis and the corresponding UPPer limit line have to be identical. If the measured values exceed the UPPer limit line, the limit check signals errors.
The unit must be identical with the unit selected by CALC:LIM:UNIT. The units DEG, RAD, S, HZ, PCT are available in the vector signal analysis mode only.

CALCulate<1|2>:LIMit<1 to 8>:UPPer:STATe

This command defines the selected limit line as upper limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:UPPer:STATe ON | OFF

Example: "CALC:LIM:UPPer:STAT ON"

Features: *RST value: OFF
SCPI: conforming

The result of the limit check can be queried with CALCulate:LIMit<1 to 8>:FAIL?.

CALCulate<1|2>:LIMit<1 to 8>:UPPer:OFFSet

This command defines an offset for the Y-axis of the selected relative upper limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:UPPer:OFFset <numeric_value>

Example: "CALC:LIM:UPP:OFFS 3dB"

Features: *RST value: 0
SCPI: device-specific

CALCulate<1|2>:LIMit<1 to 8>:UPPer:MARGin

This command defines the margin of the selected upper limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:UPPer:MARGin <numeric_value>

Example: "CALC:LIM:UPP:MARG 10dB"

Features: *RST value: 0
SCPI: device-specific

CALCulate<1|2>:LIMit<1 to 8>:UPPer:MODE

This command selects the relative or absolute scaling for the Y-axis of the selected upper limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:UPPer:MODE RELative | ABSolute

Example: "CALC:LIM:UPP:MODE REL"

Features: *RST value: ABSolute
SCPI: device-specific

CALCulate<1|2>:LIMit<1 to 8>:UPPer:SHIFt

This command shifts a limit line, which has relative values for the Y-axis (levels or linear units such as volt).

Syntax: CALCulate<1|2>:LIMit<1 to 8>:Upper:SHIFt <numeric_value>

Example: "CALC:LIM:UPP:SHIF 20dB"

Features: *RST value: --
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:LIMit<1 to 8>:LOWer[:DATA]

This command defines the values for the selected lower limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:LOWer[:DATA]
<numeric_value>,<numeric_value>..

Example: "CALC:LIM:LOW -30,-40,-40,-30"

Features: *RST value: - (LIMit:STATe is set to OFF)
SCPI: conforming

The number of values for the CONTrol axis and the corresponding LOWer limit line have to be identical. If the measured values violate the LOWer limit line, the limit check signals errors.
The unit must be identical with the unit selected by CALC:LIM:UNIT. The units DEG, RAD, S, HZ, PCT are available in the vector signal analysis mode only.

CALCulate<1|2>:LIMit<1 to 8>:LOWer:STATe

This command defines the selected limit line as lower limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:LOWer:STATe ON | OFF

Example: `"CALC:LIM:LOWer:STAT ON"`

Features: *RST value: OFF
SCPI: conforming

The result of the limit check can be queried with `CALCulate:LIMit:FAIL?`.

CALCulate<1|2>:LIMit<1 to 8>:LOWer:OFFSet

This command defines an offset for the Y-axis of the selected relative lower limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:LOWer:OFFset <numeric_value>

Example: `"CALC:LIM:LOW:OFFS 3dB"`

Features: *RST value: 0
SCPI: device-specific

CALCulate<1|2>:LIMit<1 to 8>:LOWer:MARGin

This command defines the margin of the selected lower limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:LOWer:MARGin <numeric_value>

Example: `"CALC:LIM:LOW:MARG 10dB"`

Features: *RST value: 0
SCPI: device-specific

CALCulate<1|2>:LIMit<1 to 8>:LOWer:MODE

This command selects the relative or absolute scaling for the Y-axis of the selected lower limit line.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:LOWer:MODE RELative | ABSolute

Example: `"CALC:LIM:LOW:MODE REL"`

Features: *RST value: ABSolute
SCPI: device-specific

CALCulate<1|2>:LIMit<1 to 8>:LOWer:SHIFt

This command shifts a limit line, which has relative values for the Y-axis (levels or linear units such as volt).

Syntax: CALCulate<1|2>:LIMit<1 to 8>:LOWer:SHIFt <numeric_value>

Example: `"CALC:LIM:LOW:SHIF 20dB"`

Features: *RST value: --
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:LIMit<1 to 8>:FAIL?

This command queries the result of the limit check.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:FAIL?

Example: `"CALC:LIM:FAIL?"`

Features: *RST value: -
SCPI: conforming

The result of the limit check responds with 0 in case of PASS and with 1 in case of FAIL.

CALCulate<1|2>:LIMit<1 to 8>:CLEar[:IMMediate]

This command deletes the result of the current limit check.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:CLEar[:IMMediate]

Example: `"CALC:LIM:CLE"`

Features: *RST value: -
SCPI: conforming

This command is an event which is why it is not assigned an *RST value.

CALCulate<1|2>:LIMit<1 to 8>:COMMent

This command defines a comment for the limit line selected.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:COMMent <string>

Example: `"CALC:LIM:COMM 'Upper limit for spectrum'"`

Features: *RST value: blank comment
SCPI: device-specific

CALCulate<1|2>:LIMit<1 to 8>:COPY

This command copies one limit line onto another one.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:COPY 1 to 8 | <name>
1 to 8 ::= number of the new limit line or, alternatively:
<name> ::= name of the new limit line given as a string

Example: `"CALC:LIM1:COPY 2"`
`"CALC:LIM1:COPY 'GSM2'"`

Features: *RST value: --
SCPI: device-specific

The name of the limit line may contain a maximum of 8 characters. This command is an "event" which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:LIMit<1 to 8>:NAME

This command assigns a name to a limit line numbered 1 to 8. If it doesn't exist previously, a limit line with this name is created.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:NAME <string>
<string> ::= name off limit line

Example: "CALC:LIM1:NAME 'GSM1'"

Features: *RST value: 'REM1' to 'REM8' for lines 1 to 8
SCPI: device-specific

The name of the limit line may contain a maximum of 8 characters.

CALCulate<1|2>:LIMit<1 to 8>:DELete

This command deletes the limit line selected.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:DELete

Examples: "CALC:LIM1:DEL"

Features: *RST value: --
SCPI: device-specific

This command is an "event" which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:LIMit<1 to 8>:BURSt:PTEMplate?

This command queries the result of the limit check for a power vs. time measurement.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:BURSt:PTEMplate?

Examples: "CALC:LIM:BURS:PTEM?"

The result is displayed in character data form. Possible values are:

PASSED	limit not exceeded
FAILED	limit exceeded
RUNNING	measurement not completed

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. It is available with options GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10.
If no measurement has been carried out yet, a query error is triggered off. The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:BURSt:POWer?

This command queries the total result of the carrier power measurement.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:BURSt:POWer?

The result is displayed in character data form. Possible values are:

PASSED	limit not exceeded
FAILED	limit exceeded
ABORTED	measurement aborted
RUNNING	measurement not completed

Examples: "CALC:LIM:BURS:POW?"
Result: PASSED

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. It is available with options GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10.
If the command is triggered off before the carrier power measurement was started for the first time, a query error results. The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:MODulation?

This command queries the total result of the spectrum due to modulation measurement.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:MODulation?
ARFCn | TXBand | RXBand | COMBined | DCSRx1800
ARFCn::= ARFCN ± 1.8 MHz
TXBand::= TX-band
RXBand::= RX-band
COMBined::= ARFCN ± 1.8 MHz / TX-band
DCSRx1800::= RX-Band DCS 1800 (option FSE-K10 only)

The result is displayed in character data form. Possible values are:

PASSED	limit not exceeded
FAILED	limit exceeded
ABORTED	measurement aborted
RUNNING	measurement not completed

Examples: "CALC:LIM:SPEC:MOD? RXB"
Result: PASSED

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. It is available with options GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10.
The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:MODulation:FAILs?

This command queries the number of limit violations of the spectrum due to modulation measurement.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:MODulation:FAILs?
ARFCn | TXBand | RXBand | COMBined | DCSRx1800
ARFCn::= ARFCN ± 1.8 MHz
TXBand::= TX-band
RXBand::= RX-band
COMBined::= ARFCN ± 1.8 MHz / TX-band
DCSRx1800::= RX-Band DCS 1800 (option FSE-K10 only)

Examples: "CALC:LIM:SPEC:MOD:FAIL? RXB"

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. It is available with options GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10.
The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:MODulation:EXCeptions?

This command queries the number of limit violations of the spectrum due to modulation measurement which are marked as exceptions.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:MODulation:EXCeptions?
ARFCn | TXBand | RXBand | COMBined | DCSRx1800
ARFCn::= ARFCN ± 1.8 MHz
TXBand::= TX-band
RXBand::= RX-band
COMBined::= ARFCN ± 1.8 MHz / TX-band
DCSRx1800::= RX-Band DCS 1800 (option FSE-K10 only

Examples: "CALC:LIM:SPEC:MOD:EXC? RXB"

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. It is available with options GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10.
The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:SWITching?

This command queries the total result of the spectrum due to switching transients measurements.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:SWITching?
ARFCn | TXBand | RXBand | COMBined

ARFCn::= ARFCN ± 1.8 MHz
TXBand::= TX-band
RXBand::= RX-band
COMBined::= ARFCN ± 1.8 MHz / TX-band

The result is displayed in character data form. Possible values are:

PASSED	limit not exceeded
FAILED	limit exceeded
ABORTED	measurement aborted
RUNNING	measurement not completed

Examples: "CALC:LIM:SPEC:SWIT?"
Result: PASSED

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. It is available with options GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10.
The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:SWITching:FAILs?

This command queries the number of limit violations of the spectrum due to switching transient measurement.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:SWITching:FAILs?
ARFCn | TXBand | RXBand | COMBined

ARFCn::= ARFCN ± 1.8 MHz
TXBand::= TX-band
RXBand::= RX-band
COMBined::= ARFCN ± 1.8 MHz / TX-band

Examples: "CALC:LIM:SPEC:SWIT:FAIL?"

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. It is available with options GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10.
The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:SPURious?

This command queries the total result of the spurious emissions measurement.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:SPURious?
TXBand | OTXBand | RXBand | IDLeband

TXBand::= TX-band
OTXBand::= Not TX-band
RXBand::= RX-band (option FSE-K11 only)
IDLeband::= IDLeband (option FSE-K10 only)

The result is displayed in character data form. Possible values are:

PASSED	limit not exceeded
FAILED	limit exceeded
ABORTED	measurement aborted
RUNNING	measurement not completed

Examples:
```
"CALC:LIM:SPUR? OTXB"
Result:PASSED
```

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. It is available with options GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10.
The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:SPURious:FAILs?

This command queries the number of limit violations of the spurious emissions measurement.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:SPURious:FAILs?
TXBand | OTXBand | RXBand | IDLeband

TXBand::= TX-band
OTXBand::= Not TX-band
RXBand::= RX-band (option FSE-K11 only)
IDLeband::= IDLeband (option FSE-K10 only)

Examples:
```
"CALC:LIM:SPUR:FAIL? OTXB"
```

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. It is available with option GSM BTS analyzer FSE-K11 or GSM MS Analyzer FSE-K10.
The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:MARGin

This command sets/changes the value of the margin (safe difference to the actual limit) for the limit check.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:MARGin <numeric_value>
<numeric_value> ::= 0 to 100DB

Examples:
```
"CALC:LIM:MARG 6DB"
```

Features: *RST value: 3DB
SCPI: device-specific

This command is available with options GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10 only. The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:ACPower[:STATe]

This command switches on and off the limit check for adjacent channel power measurements. The commands `CALC:LIM:ACP:ACH:STAT` or `CALC:LIM:ACP:ALT:STAT` must be used in addition to specify whether the limit check is to be performed for the upper/lower adjacent channel or for the alternate adjacent channels.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:ACPower[:STATe] ON | OFF

Examples: `"CALC:LIM:ACP ON"`

Features: *RST value: OFF
SCPI: device-specific

The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel

This command defines the limit for the upper/lower adjacent channel for adjacent channel power measurements.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel <num_value>,<num_value>
<numeric_value> ::= 0 to 100 dB.
The first (second) numeric value is the limit for the upper (lower) adjacent channel.

Examples: `"CALC:LIM:ACP:ACH 30DB, 30DB"`

Features: *RST value: 0 dB
SCPI: device-specific

The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:STATe

This command activates the limit check for the adjacent channel when adjacent channel power measurement is performed. Before, the limit check must be activated using `CALC:LIM:ACP ON`.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:STATe ON | OFF

Examples: `"CALC:LIM:ACP:ACH:STAT ON"`

Features: *RST value: OFF
SCPI: device-specific

The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:RESult?

This command queries the result of the limit check for the upper/lower adjacent channel when adjacent channel power measurement is performed.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:RESult?

The result is returned in the form <result>, <result> where
<result> = PASSED | FAILED, and where the first returned value denotes the lower, the second denotes the upper adjacent channel.

Examples: `"CALC:LIM:ACP:ACH:RES?"`

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. If the power measurement of the adjacent channel is switched off, the command triggers a query error.
The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>

This command defines the limit for the first/second alternate adjacent channel for adjacent channel power measurements.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>
<numeric_value>,<numeric_value>
<numeric_value> ::= 0 to 100DB.

The first (second) numeric value is the limit for the lower (upper) alternate adjacent channel. The numeric suffix after `ALTernate<1|2>` denotes the first or the second alternate channel.

Examples: `"CALC:LIM:ACP:ALT2 30DB 30DB"`

Features: *RST value: 0DB
SCPI: device-specific

The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:STATe

This command activates the limit check for the first/second alternate adjacent channel for adjacent channel power measurements. Before, the limit check must be activated using `CALC:LIM:ACP ON`.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:STATe ON | OFF

Examples: `"CALC:LIM:ACP:ALT2:STAT ON"`

Features: *RST value: OFF
SCPI: device-specific

The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:RESult?

This command queries the result of the limit check for the first/second alternate adjacent channel for adjacent channel power measurements.

Syntax: CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:RESult?
The result is returned in the form <result>, <result> where
<result> = PASSED | FAILED and where the first (second) returned value denotes the lower (upper) alternate adjacent channel.

Examples: `"CALC:LIM:ACP:ALT2:RES?"`

Features: *RST value: --
SCPI: device-specific

This command is a query and therefore not assigned a *RST value. If the power measurement of the adjacent channel is switched off, the command triggers a query error.
The numeric suffixes <1|2> or <1 to 8> are not significant for this command.

3.6.4.6 CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the instrument.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer<1 to 4>			
[:STATe]	<Boolean>	--	
:AOFF			no query
:TRACe	<numeric_value>	--	
:X	<numeric_value>	HZ|S	
:SLIMits			
[:STATe]	<Boolean>		
:COUNt	<Boolean>	--	
:RESolution	<numeric_value>	HZ	
:FREQuency?	--	--	query only
:COUPled			
[:STATe]	<Boolean>		
:LOEXclude	<Boolean>		
:Y?	--	--	query only
:MAXimum			
[:PEAK]	--	--	no query
:APEak	--	--	no query, Vector Signal Analysis
:NEXT	--	--	no query
:RIGHt	--	--	no query
:LEFT	--	--	no query
:MINimum			
[:PEAK]	--	--	no query
:NEXT	--	--	no query
:RIGHt	--	--	no query
:LEFT	--	--	no query
:STEP			
[:INCRement]	<numeric_value>	HZ | S | SYM	
:AUTO	<Boolean>	--	
:PEXCursion	<numeric_value>	dB	
:READout	MPHase | RIMaginary		Vector Signal Analysis
:FUNCtion			
:NDBDown	<numeric_value>	DB	
:STATe	<Boolean>		
:RESult?	--	--	query only
:FREQuency?	--	--	query only
:ZOOM	<numeric_value>	HZ	no query
:NOISe			
[:STATe]	<Boolean>		
:RESult?	--	--	query only
:DEModulation			
:SELect	AM|FM		
[:STATe]	<Boolean>		
:HOLDoff	<numeric_value>	S	
:SFACtor	<expr>		
:STATe	<Boolean>		
:RESult?	--	--	query only
:FREQuency?	--	--	query only

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer			
:FUNCtion			
:STRack	<Boolean>		
[:STATe]			
:ADEMod			Vector Signal Analysis
:AM			
[:RESult?]	PPEak | MPEak | MIDDle | RMS		query only
:FM			
[:RESult?]	PPEak | MPEak | MIDDle | RMS | RDEV		query only
:PM			
[:RESult?]	PPEak | MPEak | MIDDle | RMS		query only
:AFRequency			
[:RESult?]			query only
:FERRor			
[:RESult?]			query only
:SINad			
[:STATe]	<Boolean>		
:RESult?			query only
:CARRier			
[:RESult?]			query only
:DDEMod			Vector Signal Analysis
:RESult?	MERM | MEPK | MEPS | PERM | PEPK | PEPS |EVRM | EVPK | EVPS | IQOF | IQIM | ADR | FERR | DEV | FSRM | FSPK | FSPS | RHO |FEPK | DTTS		query only
:POWer			
:SELect	ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0		no query
:RESult?	ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0		query only
:PRESet	NADC | TETRA | PHS| PDC | CDPD | CDMA | NONE		
:CFILter	<Boolean>		
[:STATe]	OFF		no query
:SUMMary			
:MAXimum			Vector Signal Analysis
[:STATe]	<Boolean>		
:RESult?			query only
:PPEak			Vector Signal Analysis
[:STATe]	<Boolean>		
:RESult?			query only
:MPEak			Vector Signal Analysis
[:STATe]	<Boolean>		
:RESult?			query only
:MIDDle			Vector Signal Analysis
[:STATe]	<Boolean>		
:RESult?			query only
:RMS			
[:STATe]	<Boolean>		
:RESult?			query only
:MEAN			
[:STATe]	<Boolean>		
:RESult?			query only
:PHOLd	<Boolean>		
:AVERage	<Boolean>		
:AOFF			no query

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer			
:FUNCtion			
:CENTer			no query
:CSTep			no query
:STARt			no query
:STOP			no query
:MSTep			no query
:REFerence			no query

CALCulate<1|2>:MARKer<1 to 4>[:STATe]

This command switches on or off the currently selected marker. If no indication is made, marker 1 is selected automatically.

Syntax: CALCulate<1|2>:MARKer<1 to 4>[:STATe] ON | OFF

Example: "CALC:MARK3 ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:AOFF

This command switches off all active markers.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:AOFF

Example: "CALC:MARK:AOFF"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:TRACe

This command assigns the selected marker (1 to 4) to the indicated test curve.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:TRACe <numeric value>
<numeric value> ::= 1 to 4

Example: "CALC:MARK3:TRAC 2"

Features: *RST value -
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:X

This command positions the selected marker to the indicated frequency (span > 0) or time (span = 0).

Syntax: CALCulate<1|2>:MARKer<1 to 4>:X <numeric value>
<numeric value> ::= 0 to MAX (frequency) | MAX (sweep time)

Example: "CALC:MARK:X 10.7MHz"

Features: *RST value: -
SCPI: device-specific

The unit SYM is available in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits[:STATe]

This command switches between a limited (ON) and unlimited (OFF) search range.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:X:SLIMits[STATe] ON | OFF

Example: "CALC:MARK:X:SLIM ON"

features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:COUNt

This command switches on or off the frequency counter at the marker position.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:COUNt ON|OFF

Example: "CALC:MARK:COUN ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:COUNt:RESolution

This command specifies the resolution of the frequency counter.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:COUNt:RESolution <numeric value>
<numeric value> ::= 0.1 | 1 | 10 | 100 | 1000 | 10000 Hz

Example: "CALC:MARK:COUN:RES 1kHz"

Features: *RST value: 1kHz
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:COUNt:FREQuency

This command queries the result of the frequency counter.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:COUNt:FREQuency?

Example: "CALC:MARK:COUN:FREQ?"

Features: *RST value: -
SCPI: device-specific

This command is only a query and thus has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:COUPled[:STATe]

This command switches the coupling of markers on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:COUPling[:STATe] ON | OFF

Example: "CALC:MARK:COUP ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:LOEXclude

This command switches the local oscillator suppression on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:LOEXclude ON | OFF

Example: "CALC:MARK:LOEX ON"

Features: *RST value: OFF
SCPI: device-specific

The numeric suffixes 1|2 and 1 to 4 are not significant.

CALCulate<1|2>:MARKer<1 to 4>:Y?

This command queries the selected marker value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:Y?

Example: "CALC:MARK:Y?"

Features: *RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:MAXimum[:PEAK]

This command positions the marker to the current maximum value in the trace memory.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:MAXimum[:PEAK]

Example: "CALC:MARK:MAX"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:APEak

This command positions the marker to the maximum absolute value of the trace.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:MAXimum:APEak

Example: "CALC:MARK:MAX:APE"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:NEXT

This command positions the marker to the next lower maximum value in the trace memory.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:MAXimum:NEXT

Example: "CALC:MARK:MAX:NEXT"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:RIGHt

This command positions the marker to the next smaller maximum value to the right of the current value (i.e., in ascending X direction) in the trace memory.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:MAXimum:RIGHt

Example: "CALC:MARK:MAX:RIGH"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MAXimum:LEFT

This command positions the marker to the next smaller maximum value to the left of the current value (i.e., in descending X direction) in the trace memory.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:MAXimum:LEFT

Example: "CALC:MARK:MAX:LEFT"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum[:PEAK]

This command positions the marker to the current minimum value in the trace memory.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:MINimum[:PEAK]

Example: "CALC:MARK:MIN"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum:NEXT

This command positions the marker to the next higher minimum value in the trace memory.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:MINimum:NEXT

Example: "CALC:MARK:MIN:NEXT"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum:RIGHt

This command positions the marker to the next higher minimum value to the right of the current value (ie in ascending X direction).

Syntax: CALCulate<1|2>:MARKer<1 to 4>:MINimum:RIGHt

Example: "CALC:MARK:MIN:RIGH"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:MINimum:LEFT

This command positions the marker to the next higher minimum value to the left of the current value (ie in descending X direction).

Syntax: CALCulate<1|2>:MARKer<1 to 4>:MINimum:LEFT

Example: "CALC:MARK:MIN:LEFT"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:STEP[:INCRement]

This command defines the marker step width.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:STEP[:INCRement] <numeric_value>

Example: "CALC:MARK:STEP 10kHz" (frequency domain)
"CALC:MARK:STEP 5ms" (time domain)
"CALC:MARK:STEP 20SYM" (time domain)

Features: *RST value: - (STEP is set to AUTO)
SCPI: device-specific

This command sets STEP:AUTO to OFF.

CALCulate<1|2>:MARKer<1 to 4>:STEP:AUTO

This command switches the automatic adaptation of the marker step width on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:STEP:AUTO ON | OFF

Example: "CALC:MARK:STEP:AUTO OFF"

Features: *RST value: ON
SCPI: device-specific

With AUTO ON, the step width is 10% of the span.

CALCulate<1|2>:MARKer<1 to 4>:PEXCursion

This command defines the peak excursion.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:PEXCursion <numeric_value>

Example: "CALC:MARK:PEXC 10dB"

Features: *RST value: 6dB
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:READout

This command determines the type of the marker display.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:READout MPHase | RIMaginary

Example: "CALC:MARK:READ RIM"

Features: *RST value: -
SCPI: device-specific

This command is only valid in operating mode Vector Signal Analysis (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown

This command defines the "N dB Down" value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown <numeric_value>

Example: "CALC:MARK:FUNC:NDBD 3dB"

Features: *RST value: 6dB
SCPI: device-specific

The temporary markers T1 and T2 are positioned by n dB below the active reference marker. The frequency spacing of these markers can be queried with CALCulate:MARKer:FUNCtion:NDBDown:RESult?.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:STATe

This command switches the "N dB Down" function on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:STATe ON | OFF

Example: "CALC:MARK:FUNC:NDBD:STAT ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:RESult?

This command queries the frequency spacing (bandwidth) of the "N dB Down" markers.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:RESult?

Example: "CALC:MARK:FUNC:NDBD:RES?"

Features: *RST value: -
SCPI: device-specific

This command is only a query which is why it is not assigned an *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:FREQuency?

This command queries the frequencies of the "N dB Down" marker.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:FREQuency?

Example: "CALC:MARK:FUNC:NDBD:FREQ?"

Features: *RST value: -
SCPI: device-specific

The two frequency values are separated by comma and indicated in ascending order. This command is only a query which is why it is not assigned an *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ZOOM

This command defines the range to be enlarged around the active marker.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ZOOM <numeric_value>

Example: "CALC:MARK:FUNC:ZOOM 1kHz"

Features: *RST value: -
SCPI: device-specific

The subsequent frequency sweep is stopped at the marker position and the frequency of the signal is counted. This frequency becomes the new center frequency, the zoomed span is then set. This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe[:STATe]

This command switches the noise measurement on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe[:STATe]ON | OFF

Example: "CALC:MARK:FUNC:NOIS ON"

Features: *RST value: OFF
SCPI: device-specific

The noise power density is measured at the position of the markers. The result can be queried with CALCulate:MARKer:FUNCtion:NOISe:RESult?.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe:RESult?

This command queries the result of the noise measurement.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe:RESult?

Example: "CALC:MARK:FUNC:NOIS:RES?"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:SELect

This command selects the demodulation type.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:SELect AM | FM

Example: "CALC:MARK:FUNC:DEM:SEL FM"

Features: *RST value: AM
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation[:STATe]

This command switches the demodulation on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation[:STATe] ON | OFF

Example: "CALC:MARK:FUNC:DEM ON"

Features: *RST value: OFF
SCPI: device-specific

With demodulation switched on, the frequency sweep is stopped at the marker position and the signal is demodulated during the given stop time.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:HOLDoff

This command defines the duration of the stop time for the demodulation.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:HOLDoff <num_value>
<numeric_value>::= 10ms to 1000s

Example: "CALC:MARK:FUNC:DEM:HOLD 3s"

Features: *RST value: - (DEModulation is set to OFF)
SCPI: device-specific

With demodulation switched on, the frequency sweep is stopped at the marker position and the signal is demodulated during the given stop time.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor

This command defines the shape factor measurement 60dB/6dB or 60dB/3dB.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor <expr>::=(60dB/3dB) | (60dB/6dB)

Example: "CALC:MARK:FUNC:SFAC (60dB/3dB)"

Features: *RST value: (60dB/6dB)
SCPI: device-specific

The temporary markers T1 to T4 are positioned in pairs by 60dB and by 3dB or 6dB below the active reference marker. The frequency spacing ratio of these markers - the shape factor - can be queried with CALCulate:MARKer:FUNCtion:SFACtor:RESult?.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor:STATe

This command switches the shape factor measurement on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor:STATe ON | OFF

Example: "CALC:MARK:FUNC:SFAC:STAT ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor:RESult?

This command queries the result of the shape factor measurement.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor:RESult?

Example: "CALC:MARK:FUNC:SFAC:RES?"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor:FREQuency?

This command queries the frequencies of the shape factor measurement.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor:FREQuency?

Example: "CALC:MARK:FUNC:SFAC:FREQ?"

Features: *RST value: -
SCPI: device-specific

Four frequency values (at -60 dB, -6 or. -3 dB, -6 or -3 dB, -60dB) are indicated in ascending order. They are separated by a comma. This command is only a query which is why it is not assigned an *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack[:STATe]

This command switches the signal-track function on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack[:STATe] ON | OFF

Example: "CALC:MARK:FUNC:STR ON"

Features: *RST value: OFF
SCPI: device-specific

With SIGNAL TRACK function activated, the maximum signal is determined after each frequency sweep and the center frequency of this signal is set. With drifting signals the center frequency follows the signal.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:AM[:RESult?]

This command queries the results of the AM modulation measurement of the analog demodulation.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:AM[:RESult?]
PPEak | MPEak | MIDDle | RMS

Example: "CALC:MARK:FUNC:ADEM:AM? PPE"

Features: *RST value: -
SCPI: device-specific

This command is valid only in conjunction with the option Vector Signal Analysis (FSE-B7) and in the analog demodulation mode.

PPEak Result of the measurement with detector +PK
MPEak Result of the measurement with detector -PK
MIDDle Result of averaging ±PK/2
RMS Result of the measurement with detector RMS

In the modulation modes FM or PM query of the MIDDle-result is possible only.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:FM[:RESult?]

This command queries the results of the FM modulation measurement of the analog demodulation.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:FM[:RESult?]
PPEak | MPEak | MIDDle | RMS | RDEV

Example: "CALC:MARK:FUNC:ADEM:FM? PPE"

Features: *RST value: -
SCPI: device-specific

This command is valid only in conjunction with the option Vector Signal Analysis (FSE-B7) and in the analog demodulation mode.

PPEak Result of the measurement with detector +PK
MPEak Result of the measurement with detector -PK
MIDDle Result of averaging ±PK/2
RMS Result of the measurement with detector RMS

In the modulation modes FM or PM query of the MIDDle-result is possible only.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:PM[:RESult?]

This command queries the results of the PM modulation measurement of the analog demodulation.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:PM[:RESult?]
PPEak | MPEak | MIDDle | RMS

Example: "CALC:MARK:FUNC:ADEM:PM? PPE"

Features: *RST value: -
SCPI: device-specific

This command is valid only in conjunction with the option Vector Signal Analysis (FSE-B7) and in the analog demodulation mode.

PPEak Result of the measurement with detector +PK
MPEak Result of the measurement with detector -PK
MIDDle Result of averaging ±PK/2
RMS Result of the measurement with detector RMS

In the modulation modes FM or PM query of the MIDDle-result is possible only.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:AFRequency[:RESult?]

This command queries the audio frequency of the analog demodulation.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:AFRequency[:RESult?]

Example: "CALC:MARK:FUNC:ADEM:AFR? "

Features: *RST value: -
SCPI: device-specific

This command is valid only in conjunction with the option Vector Signal Analysis (FSE-B7) and in the analog demodulation mode.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:FERRor[:RESult?]

This command queries the frequency error of the analog demodulation.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:FERRor [:RESult?]

Example: "CALC:MARK:FUNC:ADEM:FERR? "

Features: *RST value: -
SCPI: device-specific

This command is valid only in conjunction with the option Vector Signal Analysis (FSE-B7) and in the analog demodulation mode.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:CARRier[:RESult?]

This command queries the results of the carrier frequency measurement.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:CARRier[:RESult?]

Example: "CALC:MARK:FUNC:ADEM:CARR?"

Features: *RST value: -
SCPI: device-specific

This command is only a query and thus has no *RST value assigned. It is valid only in the analog demodulation mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:SINad[:STATe]

This command switches the SINAD measurement on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:SINad[:STATe]
ON | OFF

Example: "CALC:MARK:FUNC:ADEM:SIN ON"

Features: *RST value: OFF
SCPI: device-specific

This command is valid only in the analog demodulation mode (option FSE-B7) with Real Time ON.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:SINad:RESult?

This command queries the results of the SINAD measurement.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:SINad:RESult?

Example: "CALC:MARK:FUNC:ADEM:SIN:RES?"

Features: *RST value: -
SCPI: device-specific

This command is only a query and thus has no *RST value assigned. It is valid only in the analog demodulation mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DDEMod:RESult?

This command queries the error measurement results of digital demodulation.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DDEMod:RESult?
MERM | MEPK | MEPS | PERM | PEPK | PEPS |
EVRM | EVPK | EVPS | IQOF | IQIM | ADR | FERR | RHO

Example: `"CALC:MARK:FUNC:DDEM:RES? EVRM"`

Features: *RST value: -
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

MERM	magnitude error in %rms	FERR	frequency error in Hz
MEPK	maximum of magnitude error in %pk	FEPK	maximum of frequency error in Hz
MEPS	symbol number by which the maximum of the magnitude error occurred	ADR	amplitude drop in dB/symbol
PERM	phase error in deg	RHO	Rho-Factor
PEPK	maximum of phase error in deg	DEV	FSK deviation in Hz
PEPS	symbol number by which the maximum of the phase error occurred		
EVRM	vector error in %rms	FSPK	maximum of FSK deviation error in Hz
EVPK	maximum of vector error in %pk	FSRM	FSK deviation error in Hz
EVPS	symbol number by which the maximum of the vector error occurred	FSPS	symbol number by which the maximum of error occurred
IQOF	I/Q-offset error in %	DTTS	trigger delay of synchronization
IQIM	I/Q Imbalance in %		

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:SELect

This command selects the power measurement and switches it on.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:SELect
ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0

Example: `"CALC:MARK:FUNC:POW:SEL ACP"`

Features: *RST value: -
SCPI: device-specific

ACPower	adjacent channel power measurement
CPOWer	channel power measurement
OBANdwidth | OBWidth	occupied bandwidth power measurement
CN	signal / noise power measurement
CN0	signal-/ noise power measurement based on 1Hz bandwidth

This command is an event which is why it is not assigned an *RST value and query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:RESult?

This command queries the results of the power measurement (see also `CALCulate:MARKer:FUNCtion:POWer:SELect`.)

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:RESult?
ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0

Example: `"CALC:MARK:FUNC:POW:RES? OBW"`

Features: *RST value: -
SCPI: device-specific

This command is only a query which is why it is not assigned an *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer[:STATe]

This command switches the power measurement off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer[:STATe] OFF

Example: "CALC:MARK:FUNC:POW OFF"

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:PRESet

This command selects the settings for power measurement of standard NADC or of standard TETRA.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:PRESet
NADC | TETRA | PDC | PHS | CDPD | CDMA | NONE

Example: "CALC:MARK:FUNC:POW:PRES NADC"

Features: *RST value: -
SCPI: device-specific

The selection of a standard influences the parameters weighting filter, channel bandwidth and spacing, resolution and video bandwidth, as well as detector and sweep time.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:CFILter

This command switches the weighting filter for the selected standard on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:CFILter ON | OFF

Example: "CALC:MARK:FUNC:POW:CFIL ON"

Features: *RST value: OFF
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MAXimum[:STATe]

This command switches on or off the measurement of the maximum of the absolute value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MAXimum[:STATe]
ON | OFF

Example: "CALC:MARK:FUNC:SUMM:MAX ON"

Features: *RST value: OFF
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MAXimum:RESult?

This command queries the results of the measurement of the maximum of the absolute value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MAXimum:RESult?

Example: "CALC:MARK:FUNC:SUMM:MAX:RES?"

Features: *RST value: -
SCPI: device-specific

This command is only a query and thus has no *RST value assigned. It is available only in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak[:STATe]

This command switches on or off the measurement of the positive peak value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak[:STATe]
ON | OFF

Example: "CALC:MARK:FUNC:SUMM:PPE ON"

Features: *RST value: OFF
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:RESult?

This command queries the result of the measurement of the positive peak value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PPEak:RESult?

Example: "CALC:MARK:FUNC:SUMM:PPE:RES?"

Features: *RST value: -
SCPI: device-specific

This command is only a query and thus has no *RST value assigned. It is available only in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MPEak[:STATe]

This command switches on or off the measurement of the negative peak value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MPEak[:STATe]
ON | OFF

Example: "CALC:MARK:FUNC:SUMM:MPE ON"

Features: *RST value: OFF
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MPEak:RESult?

This command queries the result of the measurement of the negative peak value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MPEak:RESult?

Example: "CALC:MARK:FUNC:SUMM:MPE:RES?"

Features: *RST- value: -
SCPI: device-specific

This command is only a query and thus has no *RST value assigned. It is available only in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MIDDle[:STATe]

This command switches on or off the measurement of the arithmetical mean between positive and negative peak value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MIDDle[:STATe]
ON | OFF

Example: "CALC:MARK:FUNC:SUMM:MIDD ON"

Features: *RST value: OFF
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MIDDle:RESult?

This command queries the result of the measurement of the arithmetical mean between positive and negative peak value.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MIDDle:RESult?

Example: "CALC:MARK:FUNC:SUMM:MIDD:RES? "

Features: *RST- value: -
SCPI: device-specific

This command is only a query and thus has no *RST value assigned. It is available only in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS[:STATe]

This command switches on or off the measurement of the effective (rms) value of the total trace.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS[:STATe] ON | OFF

Example: "CALC:MARK:FUNC:SUM:RMS ON"

Features: *RST value: OFF
SCPI: device-specific

This command is valid at zero span or in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:RESult?

This command queries the results of the rms value measurement.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:RMS:RESult?

Example: "CALC:MARK:FUNC:SUM:RMS:RES?"

Features: *RST value: -
SCPI: device-specific

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN[:STATe]

This command switches on or off the measurement of the mean value of the total trace.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN[:STATe]
ON | OFF

Example: "CALC:MARK:FUNC:SUMM:MEAN ON"

Features: *RST value: OFF
SCPI: device-specific

This command is valid at zero span or in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:RESult?

This command queries the result of the measurement of the mean value of the total trace.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:MEAN:RESult?

Example: "CALC:MARK:FUNC:SUMM:MEAN:RES?"

Features: *RST- value: -
SCPI: device-specific

This command is only a query and thus has no *RST value assigned.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd

This command switches on or off the peak-hold function.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd ON | OFF

Example: "CALC:MARK:FUNC:SUMM:PHOL ON"

Features: *RST value: OFF
SCPI: device-specific

The peak-hold function is reset by switching off and on, again. This command is valid at zero span or in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AVERage

This command switches the calculation of the average value on or off.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AVERage ON | OFF

Example: "CALC:MARK:FUNC:SUMM:AVER ON"

Features: *RST value: OFF
SCPI: device-specific

The calculation of the average is reset by switching off and on, again. This command is valid at zero span or in the vector signal analysis mode (option FSE-B7).

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AOFF

This command switches off all measuring functions.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AOFF

Example: "CALC:MARK:FUNC:SUMM:AOFF"

Features: *RST value: _
SCPI: device-specific

This command is an "event" and therefore has no *RST value assigned and no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CENTer

This command sets the center frequency to that of the current marker.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CENTer

Example: "CALC:MARK:FUNC:CENT"

Features: *RST value: -
SCPI: device-specific

This command is an "event" and therefore has no *RST value assigned and no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CSTep

This command sets the step width of the center frequency to the x-value of the current marker.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CSTep

Example: "CALC:MARK:FUNC:CST"

Features: *RST value: -
SCPI: device-specific

This command is an "event" and therefore has no *RST value assigned and no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STARt

This command sets the start frequency to the frequency of the current marker.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STARt

Example: "CALC:MARK:FUNC:STAR"

Features: *RST value: -
SCPI: device-specific

This command is an "event" which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STOP

This command sets the stop frequency to the frequency of the current marker.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STOP

Example: "CALC:MARK:FUNC:STOP"

Features: *RST value: -
SCPI: device-specific

This command is an "event" which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MSTep

This command sets the marker step width to the x-value of the current marker.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MSTep

Example: "CALC:MARK:FUNC:MST"

Features: *RST value: -
SCPI: device-specific

This command is an "event" which is why it is not assigned an *RST value and has no query.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:REFerence

This command sets the reference level to that of the current marker.

Syntax: CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:REFerence

Example: "CALC:MARK:FUNC:REF"

Features: *RST value: -
SCPI: device-specific

This command is an "event" and therefore has no *RST value assigned and no query.

3.6.4.7 CALCulate:MATH Subsystem

The CALCulate:MATH - subsystem allows to process data from the SENSe-subsystem in numeric expressions.

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MATH<1 to 4>			
[:EXPRession]			
[:DEFine]	<expr>	--	
:STATe	<Boolean>	--	

CALCulate<1|2>:MATH<1 to 4>[:EXPression][:DEFine]

This command defines the mathematical expression for relating traces and reference line.

Syntax: CALCulate<1|2>:MATH<1 to 4> [:EXPRession][:DEFine]<expr>
<expr>::= 'OP1 - OP2 [+ RLINE]'
OP1 ::= TRACE1 | TRACE2 | TRACE3 | TRACE4
OP2 ::= TRACE1 | TRACE2 | TRACE3 | TRACE4 | RLINE

Examples:
```
"CALC:MATH1 (TRACE1 - TRACE3 + RLINE)"
"CALC:MATH4 (TRACE4 - RLINE)"
```

Features: *RST value: -
SCPI: conforming

The operand [+ RLINE] may be used only if OP2 is different from RLINE. The numeric suffix in CALCULATE<1|2> is not significant. The numeric suffix in MATH<1 to 4> denotes the trace where the result of the mathematical operation is stored. The number must be identical to the number of the operand OP1.

CALCulate<1|2>:MATH<1 to 4>:STATe

This command switches the mathematical relation of traces on or off.

Syntax: CALCulate<1|2>:MATH**<1 to 4>**:STATe ON | OFF

Example:
```
"CALC:MATH1:STAT ON"
```

Features: *RST value: OFF
SCPI: conforming

The numeric suffix in CALCULATE<1|2> is not significant. The numeric suffix in MATH<1 to 4> denotes the trace which the command refers to.

3.6.4.8 CALCulate:UNIT Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:X			Vector Signal Analysis
:UNIT			
:TIME	S | SYM		
:UNIT			Vector Signal Analysis
:ANGLe	DEG | RAD		
:POWer	DBM | V | W | DB | PCT | UNITLESS | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ		

CALCulate<1\|2>:X:UNIT:TIME

This command selects seconds or symbols as an x-axis unit.

Syntax: CALCulate<1|2>:X:UNIT:TIME S | SYM

Example: "CALC:X:UNIT:TIME S"

Features: *RST value: _S
SCPI: device-specific

This command is only valid in vector signal analysis mode (option FSE-B7).

CALCulate<1\|2>: UNIT:ANGLe

This command selects the unit for angular measurement.

Syntax: CALCulate<1|2>:UNIT:ANGLe DEG | RAD

Example: "CALC:UNIT:ANGL DEG"

Features: *RST- value: _RAD
SCPI: device-specific

This command is only valid in vector signal analysis mode (option FSE-B7).

CALCulate<1|2>: UNIT:POWer

This command selects the unit for power.

Syntax: CALCulate<1|2>:UNIT:POWer DBM | V | W | DB | PCT | UNITLESS | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ

Example: "CALC:UNIT:POW DBM"

Features: *RST value: _
SCPI: device-specific

This command is only valid in vector signal analysis mode (option FSE-B7).

3.6.5 CALibration Subsystem

The commands of the CALibration subsystem perform instrument calibrations.

COMMAND	PARAMETERS	UNIT	COMMENT
CALibration			
[:ALL]?	--	--	query only
:BANDwidth			
[:RESolution]?	--	--	query only
:BWIDth			
[:RESolution]?	--	--	query only
:IQ?	--	--	query only / Vector Signal Analysis
:LDETector?	--	--	query only
:LOSuppression?	--	--	query only
:PPEak?	--	--	query only FSEM/FSEK only
:SHORt?	--	--	query only
:STATe	<Boolean>	--	

CALibration[:ALL]?

This command performs a complete calibration of the analyzer. A "0" is returned if the calibration was successful.

Syntax: CALibration[:ALL]?

Example: `"CAL?"`

Features: *RST value: -
SCPI: conforming

CALibration:BANDwidth | BWIDth[:RESolution]?

This command performs a calibration of the filter bandwidths. A "0" is returned if the calibration was successful.

Syntax: CALibration:BANDwidthIBWIDth[:RESolution]?

Example: `"CAL:BAND?"`

Features: *RST value: -
SCPI: device-specific

CALibration:IQ?

This command performs a calibration of the vector signal analyzer. A "0" is returned if the calibration was successful.

Syntax: CALibration:IQ?

Example: `"CAL:IQ?"`

features: *RST value: -
SCPI: device-specific

This command is valid only when option Vector Signal Analysis FSE-B7 is fitted.

CALibration:LDETector?

This command performs a calibration of the log module's characteristic and of the detectors. A "0" is returned if the calibration was successful.

Syntax: CALibration:LDETector?

Example: "CAL:LDET?"

Features: *RST value: -
SCPI: device-specific

CALibration:LOSuppression?

This command performs a calibration of the local oscillator suppression. . A "0" is returned if the calibration was successful.

Syntax: CALibration:LOSuppression?

Example: "CAL:LOS?"

Features: *RST value: -
SCPI: device-specific

This command is only valid by model '30 instruments or by instruments which have been retrofitted.

CALibration:PPEak?

This command performs a calibration of the tracking YIG filter (preselector peaking). A "0" is returned if the calibration was successful.

Syntax: CALibration:PPEak?

Example: "CAL:PPE?"

Features: *RST value: -
SCPI: device-specific

This command is only valid by the models FSEM and FSEK.

CALibration:SHORt?

This command performs a short calibration. A "0" is returned if the calibration was successful.

Syntax: CALibration:SHORt?

Example: "CAL:SHOR?"

Features: *RST value: -
SCPI: device-specific

CALibration:STATe

This command determines whether (ON) or not (OFF) the current calibration data are taken into consideration.

Syntax: CALibration:STATe ON | OFF

Example: "CAL:STAT OFF"

Features: *RST value: -
SCPI: conforming

3.6.6 CONFigure Subsystem

The CONFigure subsystem contains commands for configuring complex measurement tasks, like those provided by the option GSM BTS Analyzer (FSE-K11). The CONFigure subsystem is closely linked to the functions of the FETCH and READ subsystems, where the measurement cycles are started and/or the results of the measurements are queried.

3.6.6.1 CONFigure:BTS Subsystem

This subsystem provides the commands for configuring the GSM BTS Analyzer mode (Option FSE-K11) for analyzing the behavior of base stations corresponding to the standards P-GSM, E-GSM, DCS1800 or PCS1900.

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			
:BTS			Option FSE-K11
:ARFCn	<numeric_value>	--	
:AUTO	ONCE		
:POWer			
:CLASs	<numeric_value> | M1 | M2 | M3	--	
:STATic	<numeric_value>	--	
:DYNamic	<numeric_value>	--	
:EXPected	<numeric_value>	DBM	
:CHANnel			
:SLOT	<numeric_value>	--	
:AUTO	ONCE		
:TSC	<numeric_value>	--	
:AUTO	<Boolean>		
:SFH	<Boolean>		
:NETWork			
[:TYPE]	PGSM | EGSM | DCS | PCS		
:PHASe	1|2		
:COSiting	<Boolean>		
:TXSupp	<Boolean>		
:PRESet	--		

CONFigure:BTS:ARFCn

This command selects the number of the transmission channel of the base station.

Syntax: CONFigure:BTS:ARFCn <numeric_value>

<numeric_value>::= 1 to 124 (P-GSM phase I/II)
0 to 124, 975 to 1023 (E-GSM)
512 to 885 (DCS1800 phase I/II)
512 to 810 (PCS1900)

Example: "CONF:BTS:ARFC 67"

Features: *RST value: 1 (P-GSM phase I/II)
0 (E-GSM)
512 (DCS1800 phase I/II)
512 (PCS1900)
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:ARFCn:AUTO

This command is used to search for the channel number of the transmission channel of the base station automatically. This requires only one channel to be active.

Syntax: CONFigure:BTS:ARFCn:AUTO ONCE

Example: "CONF:BTS:ARFC:AUTO ONCE"

Features: *RST value: --
SCPI: device-specific

This command is an event and thus has no query and no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:POWer:CLASs

This command defines the power class of the base station.

Syntax: CONFigure:BTS:POWer:CLASs <numeric_value> | M1 | M2 | M3
<numeric_value> ::= 1 to 8 (P-GSM phase I/II, E-GSM, DCS1800 phase I/II)
::= 1 to 4 (PCS1900)
M1, M2, M3 ::= Power Classes for Micro BTS

Example: "CONF:BTS:POW:CLAS 4"

Features: *RST value: 4 (P-GSM phase I/II, E-GSM)
1 (DCS1800, PCS1900)
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:POWer:STATic

This command defines the static power control level of the base station.

Syntax: CONFigure:BTS:POWer:STATic <numeric_value>
<numeric_value>::= 0 to 6

Example: "CONF:BTS:POW:STAT 3"

Features: *RST value: 0
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:POWer:DYNamic

This command defines the dynamic power control level of the base station.

Syntax: CONFigure:BTS:POWer:DYNamic <numeric_value>
<numeric_value>::= 0 to 15

Example: "CONF:BTS:POW:DYN 5"

Features: *RST value: 0
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:POWer:EXPected

This command enters directly the rated output level of the base station specified by the manufacturer.

Syntax: CONFigure:BTS:POWer:EXPected <numeric_value>

Example: "CONF:BTS:POW:EXP 43DBM"

Features: *RST value: 46 dBm (P-GSM phase I/II, E-GSM)
43 dBm (DCS1800, PCS1900)
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:CHANnel:SLOT

This command selects the slot number within a transmission frame of the base station.

Syntax: CONFigure:BTS:CHANnel:SLOT <numeric_value>
<numeric_value> ::= 0 to 7

Example: "CONF:BTS:CHAN:SLOT 3"

Features: *RST value: 0
SCPI: device-specific

On changing the slot number, the number of the midamble (TSC) is automatically adapted to the slot. This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:CHANnel:SLOT:AUTO

This command automatically searches for the slot number within a transmission frame of the base station. This requires only one slot to be active.

Syntax: CONFigure:BTS:CHANnel:SLOT:AUTO ONCE

Example: "CONF:BTS:CHAN:SLOT:AUTO ONCE"

Features: *RST value: --
SCPI: device-specific

This command is an event and thus has no query and no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:CHANnel:SFH

This command defines whether the base station uses slow frequency hopping or not.

Syntax: CONFigure:BTS:CHANnel:SFH ON | OFF

Example: "CONF:BTS:CHAN:SFH ON"

Features: *RST value: OFF
SCPI: device-specific

This command is available only when spurious or transient spectrum measurement is selected. The settings for spurious measurement are independent from those selected for transient spectrum. Moreover, this command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:CHANnel:TSC:AUTO

This command couples the midamble (training sequence TSC_0 to 7) to the slot, i.e. if the slot number is changed the training sequence in the ON state is automatically adapted. In the OFF state, the training sequence set is conserved even if the slot number is changed.

Syntax: CONFigure:BTS:CHANnel:TSC:AUTO ON | OFF

Example: "CONF:BTS:CHAN:TSC:AUTO ON"

Features: *RST value: ON
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:CHANnel:TSC

This command selects the midamble (training sequence TSC_0 to 7) of the active slot.

Syntax: CONFigure:BTS:CHANnel:TSC <numeric_value>
<numeric_value> ::= 0 to 7

Example: "CONF:BTS:CHAN:TSC 3"

Features: *RST value: 0
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:NETWork[:TYPE]

This command selects the standard type according to which the base station will work.

Syntax: CONFigure:BTS:NETWork[:TYPE]PGSM | EGSM | DCS | PCS

Example: "CONF:BTS:NETW DCS"

Features: *RST value: GSM
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:NETWork:PHASe

This command selects the phase of the standard according to which the base station will work.

Syntax: CONFigure:BTS:NETWork:PHASe1|2

Example: "CONF:BTS:NETW:PHAS 2"

Features: *RST value: 1
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:COSiting

This command selects whether the base station has the "cositing" feature.

Syntax: CONFigure:BTS:COSiting ON | OFF

Example: "CONF:BTS:COSiting ON"

Features: *RST value: OFF
SCPI: device-specific

This command is available only if spurious emission measurement is selected. Moreover, it is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:TXSupp

This command defines that an additional carrier suppression of min. 20dB is taken into account for the measurement. If there is already suppression, a more sensitive setting of the instrument is selected.

Syntax: CONFigure:BTS:TXSupp ON | OFF

Example: "CONF:BTS:TXSupp ON"

Features: *RST value: OFF
SCPI: device-specific

For measurements in the RX-band the value is automatically set to ON. This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:BTS:PRESet

This command resets the parameters for the standard selected to their default values (DEFAULT SETTINGS).

Syntax: CONFigure:BTS:PRESet

Example: "CONF:BTS:PRES"

Features: *RST value: --
SCPI: device-specific

This command is an event and has thus no query and no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

3.6.6.2 CONFigure:BURSt Subsystem

This subsystem provides the commands for configuring the measurements in the GSM BTS Analyzer mode (option FSE-K11) or GSM MS Analyzer mode (option FSE-K10) which are performed on individual bursts. (carrier power, phase/frequency error, power vs. time).

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			
:BURSt			
:PFERror			Option FSE-K11&FSE-B7 or FSE-K10&FSE-B7
[:IMMediate]	--	--	
:COUNt	<numeric_value>	--	
:POWer			
[:IMMediate]	--	--	Option FSE-K11 or FSE-K10
:COUNt	<numeric_value>	--	
:CONDition	NORMal | EXTReme		
:PTEMplate			
[:IMMediate]	--	--	Option FSE-K11 or FSE-K10
:COUNt	<numeric_value>	--	
:SELect	FULL | TOP | RISing | FALLing		

CONFigure:BURSt:PFERror[:IMMediate]

This command selects measurement of the phase and frequency error of the base station or mobile.

Syntax: CONFigure: BURSt:PFERror[:IMMediate]

Example: "CONF:BURST:PFER"

Features: *RST value: --
SCPI: device-specific

This command is an event and thus has no query and no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer FSE-K11 and Vector Signal Analysis FSE-B7 or in conjunction with option GSM MS Analyzer, FSE-K10, and Vector Signal Analysis, FSE-B7.

CONFigure:BURSt:PFERror:COUNt

This command sets the number of bursts used for the determination of average and maximum value.

Syntax: CONFigure: BURSt:PFERror:COUNt <numeric_value>
<numeric_value>::= 1 to 1000

Example: "CONF:BURST:PFER:COUN 100"

Features: *RST value: 500 (GSM/DCS1800 Phase I)
200 otherwise
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer FSE-K11 or GSM MS Analyzer FSE-K10 and Vector Signal Analysis FSE-B7.

CONFigure:BURSt:POWer[:IMMediate]

This command selects measurement of the average carrier power of the base station or mobile.

Syntax: CONFigure: BURSt:POWer[:IMMediate]

Example: "CONF:BURST:POW"

Features: *RST value: --
SCPI: device-specific

This command is an event and thus has no query and no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:BURSt:POWer:COUNt

This command sets the number of bursts used for the determination of measured values.

Syntax: CONFigure: BURSt:POWer:COUNt <numeric_value>
<numeric_value>::= 1 to 1000

Example: "CONF:BURST:POW:COUN 100"

Features: *RST value: 500 (GSM/DCS1800 phase I)
200 otherwise
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:BURSt:POWer:CONDition

This command defines the conditions for power measurement.

Syntax: CONFigure: BURSt:POWer:CONDition NORMal | EXTReme

Example: "CONF:BURST:POW:COND EXTR"

Features: *RST value: NORMal
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:BURSt:PTEMplate[:IMMediate]

This command selects measurement of power of the base station or mobile vs. time.

Syntax: CONFigure: BURSt:PTEMplate[:IMMediate]

Example: "CONF:BURST:PTEM"

Features: *RST value: --
SCPI: device-specific

This command is an event and thus has no query and no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:BURSt:PTEMPlate:COUNt

This command defines the number of bursts used for determining the measured value.

Syntax: CONFigure: BURSt:PTEMplate:COUNt <numeric_value>
<numeric_value>::= 1 to 1000

Example: "CONF:BURS:PTEM:COUN 100"

Features: *RST value: 500 (GSM/DCS1800 phase I)
200 otherwise
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:BURSt:PTEMplate:SELect

This command defined the burst section to be measured.

Syntax: CONFigure: BURSt:PTEMplate:SELect FULL | TOP | RISing | FALLing

Example: "CONF:BURS:PTEM:SEL TOP"

Features: *RST value: FULL
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

3.6.6.3 CONFigure:MS Subsystem

This subsystem provides the commands for configuring the GSM MS Analyzer mode (Option FSE-K10) for analyzing the behavior of mobiles corresponding to the standards P-GSM, E-GSM, DCS1800 or PCS1900.

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			
:MS			Option FSE-K10
:ARFCn	<numeric_value>	--	
:AUTO	ONCE		
:POWer			
:CLASs	<numeric_value>	--	
:LEVel	<numeric_value>	--	
:EXPected	<numeric_value>	DBM	
:CHANnel			
:TSC	0 to 7 | AB	--	
:NETWork			
[:TYPE]	PGSM | EGSM | DCS | PCS		
:PHASe	1|2		
:TXSupp	<Boolean>		
:PRESet	–		

CONFigure:MS:ARFCn

This command selects the number of the transmission channel of the mobile.

Syntax: CONFigure:MS:ARFCn <numeric_value>

<numeric_value>::= 1 to 124 (P-GSM phase I/II)
0 to 124, 975 to 1023 (E-GSM)
512 to 885 (DCS1800 phase I/II)
512 to 810 (PCS1900)

Example: "CONF:MS:ARFC 67"

Features: *RST value: 1 (P-GSM phase I/II)
0 (E-GSM)
512 (DCS1800 phase I/II)
512 (PCS1900)
SCPI: device-specific

This command is available only in conjunction with option GSM MS Analyzer, FSE-K10.

CONFigure:MS:ARFCn:AUTO

This command selects automatically the transmission channel of the mobile.

Syntax: CONFigure:MS:ARFCn:AUTO ONCE

Example: "CONF:MS:ARFC:AUTO ONCE"

Features: *RST value: -
SCPI: device-specific

This command is available only in conjunction with option GSM MS Analyzer, FSE-K10.

CONFigure:MS:POWer:CLASs

This command defines the power class of the mobile.

Syntax: CONFigure:MS:POWer:CLASs <numeric_value>
<numeric_value> ::= 1 to 5 (P-GSM phase I)
2 to 5 (P-GSM phase II)
2 to 5 (E-GSM)
1 to 2 (DCS1800 phase I)
1 to 3 (DCS1800 phase II)
1 to 3 (PCS1900)

Example: "CONF:MS:POW:CLAS 4"

Features: *RST value: 2 (P-GSM phase I/II, E-GSM)
1 (DCS1800, PCS1900)
SCPI: device-specific

This command is available only in conjunction with option GSM MS Analyzer, FSE-K10.

CONFigure:MS:POWer:LEVel

This command defines the power control level of the mobile.

Syntax: CONFigure:MS:POWer:LEVel <numeric_value>
<numeric_value>::= 0 to 6

Example: "CONF:MS:POW:LEV 3"

Features: *RST value: 0
SCPI: device-specific

This command is available only in conjunction with option GSM MS Analyzer, FSE-K10.

CONFigure:MS:POWer:EXPected

This command enters directly the rated output level of the mobile.

Syntax: CONFigure:MS:POWer:EXPected <numeric_value>

Example: "CONF:MS:POW:EXP 43DBM"

Features: *RST value: 46 dBm (P-GSM phase I/II, E-GSM)
43 dBm (DCS1800, PCS1900)
SCPI: device-specific

This command is available only in conjunction with option GSM MS Analyzer, FSE-K10.

CONFigure:MS:CHANnel:TSC

This command selects the midamble used by the mobile.

Syntax: CONFigure:MS:CHANnel:TSC <numeric_value> | AB
<numeric_value> ::= 0 to 7 (training sequence for the Normal Burst)
AB (training sequence for the Access Burst)

Example: "CONF:MS:CHAN:TSC 3"

Features: *RST value: 0
SCPI: device-specific

This command is available only in conjunction with option GSM MS Analyzer, FSE-K10.

CONFigure:MS:NETWork[:TYPE]

This command selects the standard type according to which the mobile will work.

Syntax: CONFigure:MS:NETWork[:TYPE] PGSM | EGSM | DCS | PCS

Example: "CONF:MS:NETW DCS"

Features: *RST value: GSM
SCPI: device-specific

This command is available only in conjunction with option GSM MS Analyzer, FSE-K10.

CONFigure:MS:NETWork:PHASe

This command selects the phase of the standard according to which the mobile will work.

Syntax: CONFigure:MS:NETWork:PHASe 1 | 2

Example: "CONF:MS:NETW:PHAS 2"

Features: *RST value: 1
SCPI: device-specific

This command is available only in conjunction with option GSM MS Analyzer, FSE-K10.

CONFigure:MS:TXSupp

This command defines that an additional carrier suppression of min. 20dB is taken into account for the measurement. If there is already suppression, a more sensitive setting of the instrument is selected.

Syntax: CONFigure:MS:TXSupp ON | OFF

Example: "CONF:MS:TXSupp ON"

Features: *RST value: OFF
SCPI: device-specific

For measurements in the RX-band the value is automatically set to ON. This command is available only in conjunction with option GSM MS Analyzer, FSE-K10.

CONFigure:MS:PRESet

This command resets the parameters for the standard selected to their default values (DEFAULT SETTINGS).

Syntax: CONFigure:MS:PRESet

Example: "CONF:MS:PRES"

Features: *RST value: --
SCPI: device-specific

This command is an event and has thus no query and no *RST value assigned. It is available only in conjunction with option GSM MS Analyzer, FSE-K10.

3.6.6.4 CONFigure:SPECtrum Subsystem

This subsystem provides the commands for configuring the measurements in the GSM BTS Analyzer mode (FSE-K11) or in the GSM MS Analyzer mode (FSE-K10) used to determine the power of the spectral contributions due to modulation and switching (modulation spectrum, transient spectrum).

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			
:SPECtrum			Option FSE-K11 or FSE-K10
:MODulation			
[:IMMediate]	--	--	
:COUNt	<numeric_value>	--	
:RANGe	ARFCn | TXBand | RXBand | COMBined | DCSRx1800		
:SWITching			
[:IMMediate]	--	--	
:COUNt	<numeric_value>	--	

CONFigure:SPECtrum:MODulation[:IMMediate]

This command selects measurement of the spectrum due to modulation.

Syntax: CONFigure:SPECtrum:MODulation[:IMMediate]

Example: "CONF:SPEC:MOD"

Features: *RST value: --
SCPI: device-specific

This command is an event and has thus no query and no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:SPECtrum:MODulation:COUNt

This command sets the number of bursts used for determining the average and maximum values.

Syntax: CONFigure:SPECtrum:MODulation:COUNt <numeric_value>
<numeric_value>::= 1 to 1000

Example: "CONF:SPEC:MOD:COUN 100"

Features: *RST value: 500 (GSM/DCS1800 phase I)
200 otherwise
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:SPECtrum:MODulation:RANGe

This command selects the frequency range for the measurement.

Syntax: CONFigure:SPECtrum:MODulation:RANGe ARFCn | TXBand | RXBand | COMBined | DCSRx1800
ARFCn::= ARFCN ± 1.8 MHz
TXBand::= TX-Band
RXBand::= RX-Band
COMBined::= ARFCN ± 1.8 MHz / TX-Band
DCSRx1800::= RX band DCS 1800 (option FSE-K10 only)

Example: "CONF:SPEC:MOD:RANG TXB"

Features: *RST value: ARFCn
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:SPECtrum:SWITching[:IMMediate]

This command selects measurement of the spectrum due to switching transients.

Syntax: CONFigure:SPECtrum:SWITching[:IMMediate]

Example: "CONF:SPEC:SWIT "

Features: *RST value: --
SCPI: device-specific

This command is an event and has thus no query and no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:SPECtrum:SWITching:COUNt

This command defines the number of bursts used for determining the average and maximum values.

Syntax: CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
<numeric_value>::= 1 to 1000

Example: "CONF:SPEC:SWIT:COUN 100"

Features: *RST value: 500 (GSM/DCS1800 phase I)
200 otherwise
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

3.6.6.5 CONFigure:SPURious Subsystem

This subsystem provides commands for configuring the measurements in the GSM BTS (FSE-K11) or GSM MS (FSE-K10) Analyzer mode used for measuring the power of spurious emissions.

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			
:SPURious			Option FSE-K11 or FSE-K10
[:IMMediate]	--	--	
:COUNt	<numeric_value>	--	
:RXBand	<numeric_value>	--	
:RANGe	TXBand | OTXBand | RXBand | IDLeband	--	

CONFigure:SPURious[:IMMediate]

This command selects measurement of spurious emissions.

Syntax: CONFigure:SPURious[:IMMediate]

Example: "CONF:SPUR"

Features: *RST value: --
SCPI: device-specific

This command is an event and has thus no query and no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

CONFigure:SPURious:COUNt

This command sets the number of bursts used for determining the average and maximum values.

Syntax: CONFigure:SPURious:COUNt <numeric_value>
<numeric_value>::= 1 to 1000

Example: "CONF:SPUR:COUN 100"

Features: *RST value: 500 (GSM/DCS1800 phase I)
200 otherwise
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.
The number of bursts in measurements of the RX band is set by command CONFigure:SPURious:RANGe:RXBand (FSE K11 only).

CONFigure:SPURious:COUNt:RXBand

This command ses the number of bursts used for determining the average and maximum values in measurements of the RX band.

Syntax: CONFigure:SPURious:COUNt:RXBand <numeric_value>
<numeric_value>::= 1 to 1000

Example: "CONF:SPUR:COUN:RXB 100"

Features: *RST value: 1
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11.

CONFigure:SPURious:RANGe

This command selects the frequency range used for the measurement.

Syntax: CONFigure:SPURious:RANGe TXBand | OTXBand | RXBand
TXBand::= TX-Band
OTXBand::= Not TX-Band
RXBand::= RX-Band (option FSE-K11 only)
IDLeband::= Idle band (option FSE-K10 only)

Example: "CONF:SPUR:RANG OTX"

Features: *RST value: TXB
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

3.6.7 DIAGnostic Subsystem

The DIAGnostic subsystem contains the commands which support instrument diagnostics for maintenance, service and repair. In accordance with the SCPI standard, all of these commands are device-specific.

COMMAND	PARAMETERS	UNIT	COMMENT
DIAGnostic			
:SERVice			
:INPut			
[:SELect]	CALibration | RF	--	
:FUNCtion	<numeric_value>,>numeric_value>	--	no query
:NSOurce	<Boolean>	--	

DIAGnostic:SERVice:INPut[:SELect]

This command toggles between the RF input on the front panel and the internal 120-MHz reference signal.

Syntax: DIAGnostic:SERVice:INPut[:SELect] CALibration|RF

Example: `"DIAG:SERV:INP CAL"`

Features: *RST value: RF
SCPI: device-specific

DIAGnostic:SERVice:FUNCtion

This command activates a service function.

Syntax: DIAGnostic:SERVice:FUNCtion <numeric_value>,<numeric_value>...

Example: `"DIAG:SERV:FUNC 2,0,2,12,1"`

Features: *RST value: -
SCPI: device-specific

The service function is selected via five parameters: functional group number, board number, function number, parameter 1 and parameter 2.

See service manual 1065.6016.24.

DIAGnostic:SERVice:NSOurce

This command switches the 28-V supply at the rear connector of the noise source on and off.

Syntax: DIAGnostic:SERVice:NSOurce ON | OFF

Example: `"DIAG:SERV:NSO ON"`

Features: *RST value: OFF
SCPI: device-specific

3.6.8 DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of trace data on the display.
The displays in the split-screen mode are assigned to WINDow 1 (screen A) or 2 (screen B) .

COMMAND	PARAMETERS	UNIT	COMMENT
DISPlay			
:FORMat	SINGle | SPLit		
:PROgram			
[:MODE]	<Boolean>		option FSE-B15
:ANNotation			
:FREQuency	<Boolean>		
:LOGO	<Boolean>		
:CMAP<1 to 13>			
:DEFault			
:HSL	0 to 1,0 to 1,0 to 1		
:PDEFined	BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta		
[:WINDow<1|2>]			
:TEXT			
[:DATA]	<string>		
:STATe	<Boolean>		
:TIME	<Boolean>		
:MINFo	<Boolean>		
:TRACe<1 to 4>			
:X			
[:SCALe]			Vector Signal Analysis
:RVALue	<numeric_value>		
:ZOOM	<Boolean>		
[:FREQuency]			
:STARt	<numeric_value>	HZ	
:STOP	<numeric_value>	HZ	
:CENTer	<numeric_value>	HZ	
:Y			
[:SCALe]	<numeric_value>	DB	
:MODE	ABSolute | RELative		
:RLEVel	<numeric_value>	DBM	
:OFFSet	<numeric_value>	DB	
:RVALue	<numeric_value>	DBM|DB|HZ|DEG|RAD	Vector Signal Analysis
:AUTO	<Boolean>		Analyzer mode only
:RPOSition	<numeric_value>	PCT	Vector Signal Analysis
:PDIVision	<numeric_value>	DBM|DB|HZ|DEG|RAD	Vector Signal Analysis
:SPACing	LINear|LOGarithmic|PERCent	--	
:MODE	WRITe | VIEW | AVERage | MAXHold | MINHold	--	
:CWRite	<Boolean>	--	Vector Signal Analysis
:ANALog	<Boolean>	--	
:HCONtinuous	<Boolean>	--	
[:STATe]	<Boolean>	--	
:SYMBol	DOTS | BARS | OFF		Vector Signal Analysis
:EYE			
COUNt	<numeric_value>	SYM	Vector Signal Analysis

DISPlay:FORMat

This command switches the test result display between FULL SCREEN and SPLIT SCREEN.

Syntax: DISPlay:FORmat SINGle | SPLit

Example: "DISP:FORM SPL"

Features: *RST value: SINGle
SCPI: device-specific

DISPlay:PROGram[:MODE]

This command switches the display between the measuring instrument and the computer function.

Syntax: DISPlay:PROGram[:MODE] ON | OFF

Example: "DISP:PROG ON"

Features: *RST value: OFF
SCPI: device-specific

This command is only valid in conjunction with Option Computer Function (FSE-B15).

DISPlay:ANNotation:FREQuency

This command switches the x-axis annotation on or off.

Syntax: DISPlay:ANNotation:FREQuency ON | OFF

Example: "DISP:ANN:FREQ OFF"

Features: *RST value: ON
SCPI: conforming

DISPlay:LOGO

This command switches the factory logo on the screen on or off.

Syntax: DISPlay:LOGO ON | OFF

Example: "DISP:LOGO OFF"

Features: *RST value: ON
SCPI: device-specific

DISPlay:CMAP<1 to 13>:DEFault

This command resets the screen colors of the instrument to their default settings.

Syntax: DISPlay:CMAP<1 to 13>:DEFault

Example: "DISP:CMAP:DEF"

Features: *RST value: --
SCPI: conforming

This command is an event and has thus no query and no *RST value assigned. The numeric suffix in CMAP<1 to 13> is not significant.

DISPlay:CMAP<1 to 13>:HSL

This command defines the color table of the instrument. To each numeric suffix of CMAP is assigned one or several picture elements which can be modified by varying the corresponding color setting. The following assignment applies:

CMAP1	Trace 1	CMAP8	Softkey State Data Entry
CMAP2	Trace 2	CMAP9	Softkey State OFF
CMAP3	Trace 3	CMAP10	Softkey Shade
CMAP4	Trace 4	CMAP11	Text
CMAP5	Marker	CMAP12	Title
CMAP6	Grid	CMAP13	Background
CMAP7	Softkey State On		

Syntax: DISPlay:CMAP<1 to 13>:HSL <hue>,<sat>,<lum>
hue = TINT
sat = SATURATION
lum = BRIGHTNESS

The value range is 0 to 1 for all parameters.

Example: `"DISP:CMAP2:HSL 0.3,0.8,1.0"`

Features: *RST value: --
SCPI: conforming

The values set are not changed by *RST.

DISPlay:CMAP<1 to 13>:PDEFined

This command defines the color table of the instrument using predefined color values. To each numeric suffix of CMAP is assigned one or several picture elements which can be modified by varying the corresponding color setting. The same assignment as for `DISPlay:CMAP<1 to 13>:HSL` applies.

Syntax: DISPlay:CMAP<1 to 13>:PDEFined BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta

Example: `"DISP:CMAP2:PDEF GRE"`

Features: *RST value: --
SCPI: conforming

The values set are not changed by *RST.

DISPlay[:WINDow<1|2>]:MINFo

This command switches the marker info list on the screen on or off.

Syntax: DISPlay[:WINDow<1|2>]:MINFo ON | OFF

Example: `"DISP:MINF ON"`

Features: *RST value: OFF
SCPI: device-specific

DISPlay[:WINDow<1|2>]:TEXT[:DATA]

This command defines a comment which can be displayed on the screen.

Syntax: DISPlay[:WINDow<1|2>]:TEXT[:DATA] <string>

Example: "DISP:TEXT "signal/noise power measurement"

Features: *RST value: "" (empty)
SCPI: conforming

The numeric suffix in WINDow<1|2> is not significant.

DISPlay[:WINDow<1|2>]:TEXT:STATe

This command switches on or off the screen display of the comment.

Syntax: DISPlay[:WINDow<1|2>]:TEXT:STATe ON | OFF

Example: "DISP:TEXT:STAT ON"

Features: *RST value: OFF
SCPI: conforming

The numeric suffix in WINDow<1|2> is not significant.

DISPlay[:WINDow<1|2>]:TIME

This command switches on or off the screen display of date and time.

Syntax: DISPlay[:WINDow<1|2>]:TIME ON | OFF

Example: "DISP:TIME ON"

Features: *RST value: OFF
SCPI: device-specific

The numeric suffix in WINDow<1|2> is not significant.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:RVALue

This command defines the reference value for the X-axis of the measuring diagram.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:RVALue <numeric_value>

Example: "DISP:TRAC:X:RVAL 20SYM"

Features: *RST value: -
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:ZOOM

This command displays the zoomed current frequency range in the opposite window of the split screen representation.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:ZOOM ON | OFF

Example: "DISP:TRAC:X:ZOOM ON"

Features: *RST value: OFF
SCPI: device-specific

The numeric suffix in TRACe<1 to 4> is not significant.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:ZOOM[:FREQuency]:STARt

This command defines the start frequency of the zoomed display range. The value must lie between start and stop frequency of the original range.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:ZOOM[:FREQuency]:STARt <numeric_value>

Example: "DISP:TRAC:X:ZOOM:STAR 100MHZ"

Features: *RST value: -- (depending on the current frequency setting)
SCPI: device-specific

The numeric suffix in TRACe<1 to 4> is not significant.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:ZOOM[:FREQuency]:STOP

This command defines the stop frequency of the zoomed display range. The value must lie between start and stop frequency of the original range.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:ZOOM[:FREQuency]:STOP <numeric_value>

Example: "DISP:TRAC:X:ZOOM:STOP 200MHZ"

Features: *RST value: -- (depending on the current frequency setting)
SCPI: device-specific

The numeric suffix in TRACe<1 to 4> is not significant.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:ZOOM[:FREQuency]:CENTer

This command shifts the zoomed frequency range to the specified center frequency.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:X[:SCALe]:ZOOM[:FREQuency]:CENTer <numeric_value>

Example: "DISP:TRAC:X:ZOOM:CENT 1GHZ"

Features: *RST value: -- (depending on the current frequency setting)
SCPI: device-specific

The numeric suffix in TRACe<1 to 4> is not significant.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]

This command defines the display range of the Y-axis (level axis) with logarithmic scaling (DISP:TRAC:Y:SPAC LOG).

Syntax: DISPlay[:WINDow<1|2>:TRACe<1 to 4>:Y[:SCALe] <numeric_value>
<numeric_value>::= 10dB to 200dB

Example: "DISP:TRAC:Y 110dB"

Features: *RST value: 100dB
SCPI: device-specific

For linear scaling, (DISP:TRAC:Y:SPAC LIN | PERC) the display range is fixed and cannot be set.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:MODE

This command defines the scale of the y-axis (absolute or relative).

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:MODE ABSolute | RELative

Example: "DISP:TRAC:Y:MODE REL"

Features: *RST value: ABS
SCPI: device-specific

As long as SYSTem:DISPlay is set to OFF, this command does not directly influence the screen.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RLEVel

This command defines the reference level.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RLEVel <numeric_value>
<numeric_value>::= -200dBm to 200dBm

Example: "DISP:TRAC:Y:RLEV -60dBm"

Features: *RST value: -20dBm
SCPI: conforming

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RLEVel:OFFSet

This command defines the offset of the reference level.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RLEVel:OFFSet <numeric_value>
<numeric_value>::= -200dB to 200dB

Example: "DISP:TRAC:Y:RLEV:OFFS -10dB"

Features: *RST value: 0dB
SCPI: conforming

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RVALue

This command defines the reference value for the y-axis of the measurement diagram.
This defines the upper limit of the display range, the corresponding parameters of the manual control vary according to the measurement mode.

In the signal analysis mode the setting corresponds to the parameter MAX LEVEL

In the vector signal analysis mode the setting corresponds to the parameter REFERENCE VALUE Y AXIS.

IF option FSE-B8 to B11 (tracking generator) is fitted and the normalization in the analyzer mode is activated, the value corresponds to the parameter REFERENCE VALUE.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RVALue <numeric_value>

Example:
"DISP:TRAC:Y:RVAL -20dBm" (signal analysis)
"DISP:TRAC:Y:RVAL +1.20" (vector signal analysis)
"DISP:TRAC:Y:RVAL 0" (tracking generator)

Features: *RST value: - coupled to reference level
0 (vector signal analysis)
0 dB (tracking generator with active normalization)
SCPI: device specific

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RVALue:AUTO

This command defines whether the reference value for the y-axis of the measured diagram is coupled to the reference level (default) or can be set independently.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RVALue:AUTO ON | OFF

Example: "DISP:TRAC:Y:RVAL:AUTO ON"

Features: *RST value: ON
SCPI: device-specific

This command is available in the analyzer mode only.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RPOSition

This command defines the position of the reference value.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:RPOSition 0 to 100PCT

Example: "DISP:TRAC:Y:RPOS 50PCT"

Features: *RST value: 100PCT (FSE-B8 to B11)
50PCT (FSE-B7)
SCPI: conforming

This command is only valid in conjunction with option FSE-B7, Vector Signal Analysis, or option FSE-B8 to B11, Tracking Generator.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:PDIVision

This command defines the scaling of the Y-axis in the current unit.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y[:SCALe]:PDIVision <numeric_value>

Example: "DISP:TRAC:Y:PDIV +1.20" (FSE-B7)
"DISP:TRAC:Y:PDIV 0 dB" (FSE-B8)

Features: *RST value: -
SCPI: conforming

This command is only valid in conjunction with option FSE-B7, Vector Signal Analysis, and option FSE-B8 to B11, Tracking Generator.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y:SPACing

This command toggles between linear and logarithmic display.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:Y:SPACing
LINear | LOGarithmic | PERCent

Example: "DISP:TRAC:Y:SPAC LIN"

Features: *RST value: LOGarithmic
SCPI: conforming

The linear display can be LIN/% (PERCent) or LIN/dB (LINear).

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:MODE

This command defines the type of display and the evaluation of the traces.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:MODE
WRITe | VIEW | AVERage | MAXHold | MINHold

Example: "DISP:TRAC3:MODE MAXH"

Features: *RST value: WRITe for TRACe1, STATe OFF for TRACe2 to 4
SCPI: device-specific

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:MODE:CWRite

This command selects continuous display of the measured values (continuous write).

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:MODE:CWRite ON | OFF

Example: "DISP:TRAC3:MODE:CWR ON"

Features: *RST value: OFF
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:MODE:ANALog

This command selects continuous display of the measured values in the analyzer mode (analog trace).

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:MODE:ANALog ON | OFF

Example: "DISP:TRAC3:MODE:ANAL ON"

Features: *RST value: OFF
SCPI: device-specific

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:MODE:HCONtinuous

This command defines whether the traces in the min hold/max hold mode are reset after some definite parameter changes.

OFF The traces are reset after some definite parameter changes.

ON This mechanism is switched off.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:MODE:HCONtinuous ON | OFF

Example: "DISP:TRAC3:MODE:HCON ON"

Features: *RST value: OFF
SCPI: device-specific

In general, parameter changes require a restart of the measurement before results are evaluated (e. g. with markers). For those changes that are known to require a new measurement (e. g. modification of the span), the trace is automatically reset so that erroneous evaluations of previous results are avoided. This mechanism can be switched off for those exceptional cases where the described behavior is unwelcome.

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:SYMBol

This command determines the display of the points of decision on the trace.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:SYMBol DOTS | BARS | OFF

Example: "DISP:TRAC:SYMB BARS"

Features: *RST value: OFF
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:EYE:COUNt

This command determines the display range of the eye diagram in symbols.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>:EYE:COUNt <numeric_value>
<numeric_value> ::= 1 **to** Result Length

Example: "DISP:TRAC:EYE:COUNt 5"

Features: *RST value: 2
SCPI: device-specific

This command is available only in the vector signal analysis mode (option FSE-B7).

DISPlay[:WINDow<1|2>]:TRACe<1 to 4>[:STATe]

This command switches the display of the corresponding trace on or off.

Syntax: DISPlay[:WINDow<1|2>]:TRACe<1 to 4>[:STATe] ON | OFF

Example: "DISP:TRAC3 ON"

Features: *RST value: ON for TRACe1, OFF for TRACe2 to 4
SCPI: conforming

This command is available only in the vector signal analysis mode (option FSE-B7).

3.6.9 FETCh Subsystem

The FETCh subsystem contains commands for reading out results of complex measurement tasks like those provided by options GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10. The FETCh-subsystem is closely linked to the functions of the CONFigure and READ-subsystems, where the measurement sequences are configured, the measurements are started and their results are queried.

3.6.9.1 FETCh:BURSt Subsystem

This subsystem provides the commands for reading out results of measurements in the GSM BTS (option FSE-K11) or GSM MS (option FSE-K10) Analyzer mode, which are performed on individual bursts (Carrier Power, Phase/Frequency Error) without starting the measurement by themselves.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			Option FSE-K11 or FSE-K10
:BURSt			
:PERRor			
:RMS			
:AVERage?	--		
:MAXimum?	--		
:PEAK			
:AVERage?	--		
:MAXimum?	--		
:FERRor			
:AVERage?	--		
:MAXimum?	--		
:POWer	--		
[:IMMediate?]	--		
:ALL?	--		

FETCh:BURSt:PERRor:RMS:AVERage?

This command reads out the average of the RMS-measurement of the phase error taken over the selected number of bursts.

Syntax: FETCh:BURSt:PERRor:RMS:AVERage?

Example: "FETC:BURS:PERR:RMS:AVER?"

Features: *RST value: --
SCPI: device-specific

This command is a query and has therefore no *RST value assigned.
It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and when measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

FETCh:BURSt:PERRor:RMS:MAXimum?

This command reads out the maximum of the RMS-measurement of the phase error for the selected number of bursts.

Syntax: FETCh:BURSt:PERRor:RMS:MAXimum?

Example: "FETC:BURS:PERR:RMS:MAX?"

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

FETCh:BURSt:PERRor:PEAK:AVERage?

This command reads out the average of the peak measurement of the phase error taken over the selected number of bursts.

Syntax: FETCh:BURSt:PERRor:PEAK:AVERage?

Example: "FETC:BURS:PERR:PEAK:AVER?"

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

FETCh:BURSt:PERRor:PEAK:MAXimum?

This command reads out the maximum of the peak measurement of the phase error for the selected number of bursts.

Syntax: FETCh:BURSt:PERRor:PEAK:MAXimum?

Example: "FETCh:BURS:PERR:PEAK:MAX?"

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

FETCh:BURSt:FERRor:AVERage?

This command reads out the average of the measurement of the frequency error taken over the selected number of bursts.

Syntax: FETCh:BURSt:FERRor:AVERage?

Example: "FETCh:BURS:FERR:AVER?"

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

FETCh:BURSt:FERRor:MAXimum?

This command reads out the maximum frequency error measured over the selected number of bursts.

Syntax: FETCh:BURSt:FERRor:MAXimum?

Example: "FETCh:BURS:FERR:MAX?"

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

FETCh:BURSt:POWer[:IMMediate?]

This command reads out the result of the last step performed during the measurement of the output power of the base station or mobile.

Syntax: FETCh:BURSt:POWer[:IMMediate]?

The result is output as an ASCII string in the following format:

<Static Power Ctrl>,<Dyn Power Ctrl>,<Rat-Level>,<Act-Level>,
<Delta>,<Status>

with

<Static Power Ctrl>:	current static power control level
<Dyn Power Ctrl>:	current dynamic power control level
<Rat-Level>:	Rated value for the current power control level acc. to standard dBm
<Act-Level>:	measured power in dBm
<Delta>:	Difference between the measured power and the power at the previous static/dynamic power control level.
<Status>:	Result of limit check in character data form: PASSED no limits exceeded FAILED limit exceeded

Example: "FETC:BURS:POW?"
Result: 0,0,43,44.1,0,PASSED

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

FETCh:BURSt:POWer:ALL?

This command reads out the results of all individual steps during the measurement of the output power of the base station or mobile.

Syntax: FETCh:BURSt:POWer:ALL?

The result is output as an ASCII string in the following format:

<Static Power Ctrl>,<Dyn Power Ctrl>,<Rat-Level>,<Act-Level>,
<Delta>,<Status>

with

<Static Power Ctrl>:	current static power control level
<Dyn Power Ctrl>:	current dynamic power control level
<Rat-Level>:	Rated value for the current power control level acc. to standard dBm
<Act-Level>:	measured power in dBm
<Delta>:	Difference between the measured power and the power at the previous static/dynamic power control level.
<Status>:	Result of limit check in character data form: PASSED no limits exceeded FAILED limit exceeded

Example: "FETC:BURS:POW:ALL?"
Result:
0,0,43,44.1,0,PASSED,1,0,41,42.5,1.6,PASSED,1,1,35,32.5,5.6,FAILED

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

3.6.9.2 FETCh:SPECtrum Subsystem

This subsystem provides the commands for reading out results of measurements in the GSM BTS (FSE-K11) or GSM MS (FSE-K10) Analyzer mode, used to measure the power of the spectral contributions due to modulation and switching (modulation spectrum, transient spectrum) without first restarting a new measurement.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			Option FSE-K11 or FSE-K10
:SPECtrum			
:MODulation			
[:ALL?]	ARFCn | TXBand | RXBand | COMBined | DCSRx1800		
:SWITching			
[:ALL?]	--		

FETCh:SPECtrum:MODulation[:ALL]?

This command reads out the result of the measurement of the modulation spectrum of the base station or mobile.

Syntax: FETCh:SPECtrum:MODulation[:ALL]? ARFCn | TXBand | RXBand | COMBined | DCSRx1800

ARFCn::= ARFCN ± 1.8 MHz
TXBand::= TX-Band
RXBand::= RX-Band
COMBined::= ARFCN ± 1.8 MHz / TX-Band (option FSE-K11 only)
DCSRx1800::= RX band DCS 1800 (option FSE-K10 only)

The result is output as a list of partial result strings separated by ',' in the following (ASCII) format:

<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status> [,
<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status>]...

where the parts between '[...]' denote a partial result string that can be repeated n times.

<Index>: 0, if the partial result string characterizes a measurement range
current number <>0,
if the partial result string characterizes a single limit excess.

<Freq1>: Start frequency of the measurement range or frequency where the limit line is exceeded

<Freq2>: Start frequency of the measurement range or frequency exceeding the measurement range. The value of <Freq2> is equal to the value of <Freq1>, if either the measurement is performed in the time domain or if the partial result string contains a limit excess.

<Level>: Measured maximum level of the partial range or measured level at the test point.

<Limit>: Limit in the partial range or at the test point

<Abs/Rel>: ABS <Level> and <Limit> are in absolute units (dBm)
REL <Level> and <Limit> are in absolute units (dBm)

<Status>: Result of the limit check in character data form:
PASSED no limit exceeded
FAILED limit exceeded
MARGIN margin exceeded
EXC limit excess marked as an exception

The frequencies <Freq1> and <Freq2> are always absolute i. e. not referred to the carrier frequency.

Example: "FETC:SPEC:MOD? TXB"
Result: 0,890E6,915E6,-87.4,-108.0,ABS,FAILED,
1,893.2E6,893.2E6,-83.2,-108.0,ABS,FAILED,
2,895.7E6,895.7E6,-87.4,-108.0,ABS,FAILED

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the modulation spectrum is selected (see CONFigure:SPECtrum:MODulation).

FETCh:SPECtrum:SWITching[:ALL]?

This command reads out the result of the measurement of the transient spectrum of the base station or mobile.

Syntax: FETCh:SPECtrum:SWITching[:ALL]?

The result is output as a list of partial result strings separated by ',' as for the command FETCh:SPECtrum:MODulation[:ALL?].

Example: "FETC:SPEC:SWIT?"
Result: 0,833.4E6,833.4E6,37.4,-36.0,ABS,MARGIN,
1,834.0E6,834.0E6,-35.2,-36.0,ABS,FAILED,
2,834.6E6,834.6E6,-74.3,-75.0,REL,FAILED
0,835.0E6,835.0E6,-65,0,-60.0,REL,PASSED

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the transient spectrum is selected (see CONFigure:SPECtrum:MODulation).

3.6.9.3 FETCh:SPURious Subsystem

This subsystem provides the commands for reading out results of measurements in the GSM BTS (FSE-K11) or GSM MS (FSE-K10) Analyzer mode which are used to determine spurious emissions, without first restarting a new measurement.

COMMAND	PARAMETERS	UNIT	COMMENT
FETCh			Option FSE-K11 or FSE-K10
:SPURIOUS			
[:ALL?]	TXBand | OTXBand | RXBand | IDLeband		
:STEP?	--		

FETCh:SPURious[:ALL]?

This command reads out the results of the measurement of spurious emissions of the base station or mobile which is performed in the LIST mode.

Syntax: FETCh:SPURious[:ALL]? TXBand | OTXBand | RXBand | IDLeband

TXBand::= TX-band
OTXBand::= Not TX-band
RXBand::= RX-band (option FSE-K11 only)
IDLeband::= Idle band (option FSE-K10 only)

The result is output as a list of partial result strings separated by ',' in the following (ASCII) format:

<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status> [,
<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status>]...

where the parts between '[...]' denote a partial result string that can be repeated n times.

<Index>: 0, if the partial result string characterizes a measurement range
current number <>0,
if the partial result string characterizes a single limit excess.

<Freq1>: Start frequency of the measurement range or frequency where the limit line is exceeded

<Freq2>: Start frequency of the measurement range or frequency exceeding the measurement range. The value of <Freq2> is equal to the value of <Freq1>, if either the measurement is performed in the time domain or if the partial result string contains a limit excess.

<Level>: Measured maximum level of the partial range or measured level at the test point.

<Limit>: Limit in the partial range or at the test point

<Abs/Rel>: ABS <Level> and <Limit> are in absolute units (dBm)
REL <Level> and <Limit> are in absolute units (dBm)

<Status>: Result of the limit check in character data form:
PASSED no limit exceeded
FAILED limit exceeded
MARGIN margin exceeded

Example: "FETC:SPUR? TXB"
Result: 0,890E6,915E6,-87.4,-108.0,ABS,FAILED,
1,893.2E6,893.2E6,-83.2,-108.0,ABS,FAILED,
2,895.7E6,895.7E6,-87.4,-108.0,ABS,FAILED

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.

This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the spurious emissions is selected (see CONFigure:SPURious).

FETCh:SPURious:STEP?

This command reads out the result of the last single step of the measurement of spurious emissions performed in the STEP mode.

Syntax: FETCh:SPURious:STEP?

The result is output as a list of partial result strings separated by ',' as for the command FETCh:SPURious[:ALL?].

Example: "FETC:SPUR:STEP?"
Result: 0,890E6,915E6,-87.4,-108.0,ABS,FAILED,
1,893.2E6,893.2E6,-83.2,-108.0,ABS,FAILED,
2,895.7E6,895.7E6,-87.4,-108.0,ABS,FAILED

Features: *RST value: --
SCPI: device-specific

If no measurement has been performed yet, a query error results.

This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the spurious emissions is selected (see CONFigure:SPURious).

3.6.10 FORMat Subsystem

The FORMat subsystem specifies the data format of the data transmitted from and to the analyzer.

COMMAND	PARAMETERS	UNIT	COMMENT
FORMat [:DATA]	ASCii|REAL|UINT[,<numeric_value>]	-	

FORMat[:DATA]

This command specifies the data format of the data transmitted from and to the analyzer.

Syntax: FORMat[:DATA] ASCii | REAL| UINT[,<numeric_value>]
<numeric_value> ::= 32

Example:
```
"FORM REAL,32"
"FORM ASC"
```

Features: *RST value: ASCii
SCPI: conforming

The data format is either ASCii or one of the formats REAL or UINT (Unsigned Integer). ASCii data are transmitted in plain text, separated by commas. REAL data are transmitted as 32-bit IEEE 754 floating-point numbers in the "definite length block". The format UINT is only used in operating mode Vector Signal Analysis, for the symbol table.

The FORMat command is valid for the transmission of trace data. The data format of trace data received by the analyzer is automatically recognized, regardless of the format which is programmed.

3.6.11 HCOPy Subsystem

The HCOPy subsystem controls the output of display information for documentation purposes on output devices or files.

COMMAND	PARAMETERS	UNIT	COMMENT
HCOPy			
:ABORt	–		no query
:DESTination<1|2>	'SYST:COMM:GPIB'| 'SYST:COMM:SER1'| 'SYST:COMM:SER2'| 'SYST:COMM:CENT'| 'MMEM'		no query
:DEVice			
:COLor	<Boolean>		
:LANGuage<1|2>	HPGL | PCL4 | PCL5 | POSTscript | ESCP | WMF| PCX | HP7470 | EPSON24 | EPSON24C | PCL4_C | PCL4_C3 | LASERJ | DESKJ | DESKJ_C | DESKJ_C3 | HPGL_LS | HP7470LS		
:PRESet<1|2>	<Boolean>		
:RESolution<1|2>	<numeric_value>		
[:IMMediate<1|2>]	–		
:ITEM			no query
:ALL			
:FFEed<1|2>			no query
:STATe	<Boolean>		
:LABEL			
:TEXT	<string>		
:PFEed<1|2>			
:STATe	<Boolean>		
:WINDow<1|2>			
:TABle			
:STATe	<Boolean>		
:TEXT	<string>		
:TRACe			
:STATe	<Boolean>		
:CAINcrement	<Boolean>		
:PAGE			
:DIMensions			
:QUADrant<1 to 4>			no query
:FULL			no query
:ORIentation<1|2>	LANDscape|PORTrait		

HCOPy:ABORt

This command aborts a running hardcopy output.

Syntax: HCOPy:ABORt

Example: `"HCOP:ABOR"`

Features: *RST value: -
SCPI: conforming

This command is an event which is why it is not assigned an *RST value and no query.

HCOPy:DESTination<1|2>

This command selects the interface and the configuration (1 or 2) for the hardcopy device.

Syntax: HCOPy:DESTination<1|2> '<string>
<string>::= 'SYST:COMM:GPIB' |
'SYST:COMM:SER1' |
'SYST:COMM:SER2' |
'SYST:COMM:CENT' |
'MMEM'

Example: `"HCOP:DEST2 'SYST:COMM:SER2'"`

Features: *RST value: -
SCPI: conforming

This command is an event which is why it is not assigned an *RST value and no query. `HCOPy:DESTination 'MMEM'` creates a file for the hardcopy output. Command `MMEM:NAME <file_name>` defines the file name.

HCOPy:DEVice:LANGuage<1|2>

This command determines the data format of the printout.

Syntax: HCOPy:DEVice:LANGuage HPGL | PCL4 | PCL5 | POSTscript | ESCP | WMF| PCX | HP7470 | EPSON24| EPSON24C | PCL4_C | PCL4_C3 | LASERJ | DESKJ | DESKJ_C | DESKJ_C3 | HPGL_LS | HP7470LS

Example: `"HCOP:DEV:LANG WMF"`

Features: *RST value: -
SCPI: conforming

HPGL	data format for printout on a plotter in HPGL,
HP7470	special format for printout on a plotter hp7470 (reduced HPGL format)
HPGL_LS and HP7470LS	special HPGL/HP7470-format allowing output of the traces with variable Line_styles
PCL4.and PCL5	generic data formats for laser and ink-jet printers, with PCL4: Black/white PCL4_C: Color (3 color cartridges + black cartridge) PCL4_C3: Color (3 color cartridges only) PCL5: Black/white with 300DPI resolution, new language version.
LASERJ	Data format for HP-laserjet starting with series III
DESKJ...	Data formats for printers of HP-deskjet series, with DESKJ: Black/white DESKJ_C: Color (3 color cartridges + black cartridge, e. g. Deskjet 560) DESKJ_C3: Color (3 color cartridges only, e. g. Deskjet 500)
POSTscript	a printer language,
ESCP	data format for a 24-pin printer.
EPSON24	data format for Epson-compatible 24-needle printers, black/white, e. g. Epson LQ-series, R&S PDN
EPSON24C	data format for Epson-compatible 24-needle color printers, e. g. Epson Stylus Color, R&S PDN Color
WMF (WINDOWS Metafile Format) and PCX (pixel graphics)	data formats for output files which can at a later time be directly integrated in corresponding programs for documentation purposes.

HCOPy:DEVice:COLor

This command selects between color and monochrome hardcopy of the screen.

Syntax: HCOPy:DEVice:COLor ON|OFF

Example: "HCOP:DEV:COL ON"

Features: *RST value: OFF
SCPI: conforming

HCOPy:DEVice:PRESet<1|2>

This command resets the hardcopy unit (1 or 2) prior to generating the hardcopy.

Syntax: HCOPy:DEVice:PRESet<1|2> ON|OFF

Example: `"HCOP:DEV:PRES2 ON"`

Features: *RST value: OFF
SCPI: device-specific

HCOPy:DEVice:RESolution<1|2>

This command controls the resolution of the printout in PCL4 and HP-deskjet format (hardcopy unit 1 or 2).

Syntax: HCOPy:DEVice:RESolution<1|2> 150 | 300

Example: `"HCOP:DEV:RES 300"`

Features: *RST value: 150
SCPI: conforming

The resolution for an output in PCL4 format is between 150 dpi or 300 dpi.

HCOPy[:IMMediate<1|2>]

This command starts a hardcopy output.

Syntax: HCOPy[:IMMediate<1|2>]

Example: `"HCOP"`

Features: *RST value: -
SCPI: conforming

`HCOP[1]` starts the hardcopy output to device 1 (default), `HCOP2` starts the output to device 2. This command is an event which is why it is not assigned an *RST value and has no query.

HCOPy:DEVice:ITEM:ALL

This command selects the complete screen to be output.

Syntax: HCOPy:DEVice:ITEM:ALL

Example: `"HCOP:DEV:ITEM:ALL"`

Features: *RST value: OFF
SCPI: conforming

The hardcopy output is always provided with comments, title, time and date. As an alternative to the whole screen, only traces (commands `'HCOPy:DEVice:WINDow:TRACe: STATe ON'`) or tables (command `'HCOPy:DEVice:WINDow:TABLe:STATe ON'`) can be output.

HCOPy:DEVice:ITEM:FFEed<1|2>:STATe

The command adds a form feed command to the hardcopy output of the screen.

Syntax: HCOPy:DEVice:ITEM:FFEed<1|2>:STATe ON|OFF

Example: `"HCOP:DEV:ITEM:FFE2:STAT ON"`

Features: *RST value: OFF
SCPI: conforming

HCOPy:DEVice:ITEM:LABel:TEXT

This command defines the title of the screen.

Syntax: HCOPy:DEVice:ITEM:LABel:TEXT <string>

Example: `"HCOP:DEV:ITEM:LAB:TEXT 'My Title'"`

Features: *RST value: OFF
SCPI: conforming

HCOPy:DEVice:ITEM:PFEed<1|2>:STATe

This command adds a paper feed command to the hardcopy output of the screen (ON).

Syntax: HCOPy:DEVice:ITEM:PFEed<1|2>:STATe ON|OFF

Example: `"HCOP:DEV:ITEM:PFE2:STAT ON"`

Features: *RST value: OFF
SCPI: device-specific

HCOPy:DEVice:ITEM:WINDow<1|2>:TABle:STATe

This command selects the output of the currently displayed tables (ON).

Syntax: HCOPy:DEVice:ITEM:WINDow<1|2>:TABle:STATe ON | OFF

Example: `"HCOP:DEV:ITEM:WIND:TABL:STAT ON"`

Features: *RST value: OFF
SCPI: device-specific

The command `HCOPy:DEVice:ITEM:WINDow<1|2>:TABle:STATe OFF` same as command `HCOPy:DEVice:ITEM:ALL` enables the output of the whole screen.

HCOPy:DEVice:ITEM:WINDow<1|2>:TEXT

This command defines the comment text for printout to trace 1 or 2.

Syntax: HCOPy:DEVice:ITEM:WINDow<1|2>:TEXT <string>

Example: `"HCOP:DEV:ITEM:WIND2:TEXT 'comment'"`

Features: *RST value: -
SCPI: device-specific

HCOPy:DEVice:ITEM:WINDow<1|2>:TRACe:STATe

This command selects the output of the currently displayed trace (ON).

Syntax: HCOPy:DEVice:ITEM:WINDow<1|2>:TRACe:STATe ON | OFF

Example: `"HCOP:DEV:ITEM:WIND:TRACe:STAT ON"`

Features: *RST value: OFF
SCPI: device-specific

The command `HCOPy:DEVice:ITEM:WINDow<1|2>:TRACe:STATe OFF` same as command `HCOPy:DEVice:ITEM:ALL` enables the output of the whole screen.

HCOPy:DEVice:ITEM:WINDow<1|2>:TRACe:CAINcrement

The command automatically changes the colour of the currently displayed trace after printout (ON).

Syntax: HCOPy:DEVice:ITEM:WINDow<1|2>:TRACe:CAINcrement ON | OFF

Example: `"HCOP:DEV:ITEM:WIND:TRACe:CAIN ON"`

Features: *RST value: OFF
SCPI: device-specific

The automatic change of colour of the trace allows outputting to a plotter of several traces of the same diagram. For a better distinction, the colour of the trace is changed ("Color Auto Increment").

HCOPy:PAGE:DIMensions:QUADrant

The command defines the quadrant which is allocated to the screen output.

Syntax: HCOPy:PAGE:DIMensions:QUADrant<1 to 4>

Example: `"HCOP:PAGE:DIM:QUAD1"`

Features: *RST value: -
SCPI: conforming

The quadrants are defined as QUAD1 at the top right, QUAD2 at the top left, QUAD3 at the bottom left and QUAD4 at the bottom right. This command is an event which is why it is not assigned an *RST value and has no query.

HCOPy:PAGE:DIMensions:FULL

This command defines that the full screen is to be printed out.

Syntax: HCOPy:PAGE:DIMensions:FULL

Example: `"HCOP:PAGE:DIM:FULL"`

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned and *RST value and has no query.

HCOPy:PAGE:ORIentation<1|2>

The command selects the format of the output (portrait and landscape) (hardcopy unit 1 or 2).

Syntax: HCOPy:PAGE:ORIentation<1|2> LANDscape | PORTrait

Example: `"HCOP:PAGE:ORI LAND"`

Features: *RST value: -
SCPI: conforming

3.6.12 INITiate Subsystem

The INITiate subsystem checks the initialization of the trigger subsystem. In the split-screen representation, a distinction is made between INITiate1 (screen A) and INITiate2 (screen B)

COMMAND	PARAMETERS	UNIT	COMMENT
INITiate<1|2>			
:CONTinuous	<boolean>	--	
[:IMMediate]	--	--	no query
:DISPlay	<boolean>	--	

INITiate<1|2>:CONTinuous

This command determines if the trigger system is continuously initiated ("Free Run").

Syntax: INITiate<1|2>:CONTinuous ON | OFF

Example: `"INIT:CONT OFF"`

Features: *RST value: ON
SCPI: conforming

Setting "`INITiate:CONTinuous ON`" corresponds to function SWEEP CONTinuous, ie the sweep of the analyzer is cyclically repeated. The setting "`INITiate:CONTinuous OFF`" corresponds to function SWEEP SINGLE.

INITiate<1|2>[:IMMediate]

The command initiates a new sweep or starts a single sweep.

Syntax: INITiate<1|2>[:IMMediate]

Example: `"INIT"`

Features: *RST value: -
SCPI: conforming

This command is an event which is why it is not assigned an *RST value and has no query.

INITiate<1|2>:DISPlay

This command switches the display on or off during a single sweep.

Syntax: INITiate<1|2>:DISPlay ON | OFF

Example: `"INIT:DISP OFF"`

Features: *RST value: ON
SCPI: device-specific

3.6.13 INPut Subsystem

The INPut subsystem checks the input features of the instrument. In the split-screen representation, a distinction is made between INPut1 (screen A) and INPut2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
INPut<1|2>			
:ATTenuation	<numeric_value>	DB	
:AUTO	<Boolean>	--	
:MODE	NORMal | LNOise|LDIStortion	--	
:UPORt<1|2>			
[:VALue?]	--	--	query only
:STATe	<Boolean>	--	
:IMPedance	50 | 75	OHM	
:CORRection	RAM | RAZ		
:MIXer	<numeric_value>	DBM	

INPut<1|2>:ATTenuation

This command programs the input attenuator.

Syntax: INPut<1|2>:ATTenuation <numeric_value>
<numeric_value>::= 0 to 70 dB

Example: `"INP:ATT 40dB"`

Features: *RST value: - (AUTO is set to ON)
SCPI: conforming

The input attenuator can be programmed in steps of 10 dB. If the attenuation is directly programmed, the coupling to the reference level is switched off.

INPut<1|2>:ATTenuation:AUTO

This command automatically couples the input attenuation to the reference level.

Syntax: INPut<1|2>:ATTenuation:AUTO ON | OFF

Example: `"INP:ATT:AUTO ON"`

Features: *RST value: ON
SCPI: conforming

INPut<1|2>:ATTenuation:AUTO:MODE

This command optimizes the coupling of the input attenuation to the reference level to high sensitivity or to high intermodulation immunity.

Syntax: INPut<1|2>:ATTenuation:AUTO:MODE NORMal | LNOise | LDIStortion

Example: `"INP:ATT:AUTO:MODE LDIS"`

Features: *RST value: ON
SCPI: device-specific

For `LNOise`, the input attenuator value is set 10 dB lower than for `INPut:ATTenuation:AUTO:MODE NORMal`, for `LDIStortion` it is set 10 dB higher.

INPut<1|2>:UPORt<1|2>[:VALue]?

This command queries the control lines of the user ports.

Syntax: INPut<1|2>:UPORt<1|2>[:VALue]?

Example: `"INP:UPOR2?"`

Features: *RST value: -
SCPI: device-specific

This command is a query command which is why it is not assigned an *RST value.

INPut<1|2>:UPORt<1|2>:STATe

This command toggles the control lines of the user ports between INPut and OUTPut.

Syntax: INPut<1|2>:UPORt<1|2>:STATe ON | OFF

Example: `"INP:UPOR2:STAT ON"`

Features: *RST value: ON
SCPI: device-specific

With ON, the user port is switched to INPut, with OFF to OUTPut.

INPut<1|2>:IMPedance

This command sets the nominal input impedance of the analyzer.

Syntax: INPut<1|2>:IMPedance 50 | 75

Example: `"INP:IMP 75"`

Features: *RST value: 50
SCPI: conforming

Switching the input impedance to 75 Ω includes the matching elements RAM or RAZ selected by the command `INPut:IMPedance:CORRection`.

INPut<1|2>:IMPedance:CORRection

This command selects the matching element for 75 Ω input impedance.

Syntax: INPut<1|2>:IMPedance:CORRection RAM | RAZ

Example: `"INP:IMP:CORR RAM"`

Features: *RST value: - (INPut:IMPedance = 50 Ω)
SCPI: device-specific

INPut<1|2>:MIXer

This command defines the nominal mixer level of the analyzer.

Syntax: INPut<1|2>:MIXer <numeric value>
<numeric_value>::= -10 to -100 dBm

Example: `"INP:MIX -30"`

Features: *RST value: -
SCPI: device-specific

3.6.14 INSTrument Subsystem

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

COMMAND	PARAMETERS	UNIT	COMMENT
INSTrument<1|2>			
[:SELect]	SANalyzer | DDEMod | ADEMod | BSGM | MGSM		Vector Signal Analysis FSE-K11 or FSE-K10
:NSELect	<numeric_value>		
:COUPle	NONE | MODE | X | Y | CONTrol | XY | XCONtrol | YCONtrol | ALL		

INSTrument[:SELect]

This command switches between the operating modes by means of text parameters.

Syntax: INSTrument[:SELect] SANalyzer | DDEMod | ADEMod | BGSM
SANalyzer: spectrum analysis
DDEMod: vector signal analysis, digital demodulation
ADEMod: vector signal analysis, analog demodulation
BGSM: GSM BTS analysis
MGSM: GSM MS analysis

Example: `"INST DDEM"`

Features: *RST value: SANalyzer
SCPI: conforming

Switchover to DDEMod or ADEMod is only possible in conjunction with option FSE-B7, Vector Signal Analysis.
Switchover to BGSM is only possible in conjunction with option FSE-K11, GSM BTS Analyzer
Switchover to MGSM is only possible in conjunction with option FSE-K10, GSM MS Analyzer

INSTrument:NSELect

This command switches between the two modes by means of numbers.

Syntax: INSTrument:NSELect 1 | 2 | 3 | 4
1: spectrum analysis
2: vector signal analysis, digital demodulation
3: vector signal analysis, analog demodulation
4: GSM BTS analysis
5: GSM MS analysis

Example: `"INST:NSEL 2"`

Features: *RST value: 1
SCPI: conforming

Switchover to 2 or 3 is only possible in conjunction with option FSE-B7, Vector Signal Analysis.
Switchover to 4 is only possible in conjunction with option FSE-K11, GSM BTS Analyzer
Switchover to 5 is only possible in conjunction with option FSE-K10, GSM MS Analyzer

INSTrument:COUPle

This command defines the coupling between the two measurement windows screen A and B.

Syntax: INSTrument:COUPle NONE | MODE | X | Y | CONTrol | XY | XCONtrol | YCONtrol | ALL

Example: `"INST:COUP NONE"`

Features: *RST value: ALL
SCPI: device specific

NONE	no coupling.
MODE	the operating mode of the two screens is coupled.
X or Y	the scaling of the x- or y axis of the two screens is coupled.
CONTrol	the trigger and gate parameter ,and the sweep parameters SINGle/ CONTinous and COUNt of the two screens are coupled.
XY	the scaling of the x- and y-axis of the two screens are coupled.
XCONTrol bzw. YCONTrol	the trigger and gate parameter, and the sweep parameters SINGle CONTinous/ COUNt of the two screens are coupled.
ALL	the scaling of the x- or y axis the trigger and gate parameter and the sweep parameters SINGle/ CONTinous/ COUNt of the two screens are coupled.

3.6.15 MMEMory Subsystem

The MMEMory (mass memory) subsystem provides commands which allow for access to the storage media of the instrument and for storing and loading various instrument settings.
The NAME command stores the HCOPy outputs in a file.
The various drives can be addressed via the mass storage unit specifier <msus> using the conventional DOS syntax. The internal hard disk is addressed by "C:", the floppy-disk drive installed by "A:".
The file names <file_name> are indicated as string parameters with the commands being enclosed in quotation marks. They correspond to the DOS conventions.
DOS file names consist of max. 8 ASCII characters and an extension of up to three characters separated from the file name by a colon "." Both, the colon and the extension are optional. The colon is not part of the file name. DOS file names do not differ between uppercase and lowercase notation. All letters and digits are permitted as well as the special characters "_", "^", "$", "~", "!", "#", "%", "&", "-", "{", "}", "(", ")", "@" and "`". Reserved file names are CLOCK$, CON, AUX, COM1 to COM4, LPT1 to LPT3, NUL and PRN.
The two characters "*" and "?" have the function of so-called "wildcards", i.e., they are variables for selection of several files. The question mark "?" replaces exactly one character which may be any, the asterisk means any of the remaining characters in the file name. "*.*" thus means all files in a directory.

COMMAND	PARAMETERS	UNIT	COMMENT
MMEMory			
:CDIRectory	<directory_name>	--	
:COPY	<file_name>,<file_name>	--	no query
:DELete	<file_name>	--	no query
:INITialize	<msus>	--	no query
:LOAD			
:STATe	1,<file_name>	--	no query
:AUTO	1,<file_name>	--	no query
:MDIRectory	<directory_name>	--	no query
:MOVE	<file_name>,<file_name>	--	no query
:MSIS	<msus>	--	
:NAME	<file_name>	--	
:RDIRectory	<directory_name>	--	no query
:STORe			
:STATe	1,<file_name>	--	no query
:CLEar			
:STATe	1,<file_name>	--	no query
:ALL			no query
:SELect			
[:ITEM]			
:GSETup	<Boolean>		
:HWSettings	<Boolean>		
:TRACE<1 to 4>	<Boolean>		
:LINes			
[:ACTive]	<Boolean>		
:ALL	<Boolean>		
:CSETup	<Boolean>		
:HCOPy	<Boolean>		
:MACRos	<Boolean>		
:SCData	<Boolean>		Option FSE-B8 to B11
:TRANsducer			
[:ACTive]	<Boolean>		
:ALL	<Boolean>		
:ALL	--		no query
:NONE	--		no query
:DEFault	--		no query
:COMMent	<string>		

MMEMory:CDIRectory

This command changes the current directory.

Syntax: MMEMory:CDIRectory <directory_name>
<directory_name>::= DOS path name

Example: "MMEM:CDIR 'C:\USER\DATA'"

Features: *RST value: -
SCPI: conforming

In addition to the path name, the indication of the directory may contain the drive name. The path name complies with the DOS conventions.

MMEMory:COPY

This command copies the files indicated.

Syntax: MMEMory:COPY <file_source>,<file_destination>
<file_source>,<file_destination> ::= <file_name>
<file_name> ::= DOS file name

Example: "MMEM:COPY 'C:\USER\DATA\SETUP.CFG','A:'"

Features: *RST value: -
SCPI conforming

The indication of the file name may include the path and the drive. The file names and path information must be in accordance with the DOS conventions. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:DELete

This command deletes the files indicated.

Syntax: MMEMory:DELete <file_name>
<file_name> ::= DOS file name

Example: "MMEM:DEL 'TEST01.HCP'"

Features: *RST value: -
SCPI: conforming

The indication of the file name contains the path and, optionally, the drive. Indication of the path corresponds to the DOS conventions. The file name includes indication of the path and may also include the drive. The path name corresponds to the DOS conventions. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:INITialize

This command formats the disk in drive A.

Syntax: MMEMory:INITialize <msus>
<msus> ::= 'A:'

Example: "MMEM:INIT 'A:'"

Features: *RST value: -
SCPI: conforming

Formatting deletes all data stored on the floppy disk. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:LOAD:STATe

This command loads instrument settings from files.

Syntax: MMEMory:LOAD:STATe 1,<file_name>
<file_name> ::= DOS file name without extension

Example: "MMEM:LOAD:STAT 1,'A:TEST'"

Features: *RST value: -
SCPI: conforming

The contents of the file is loaded and set as new instrument state. The file name includes indication of the path and may also include the drive. The path name corresponds to the DOS conventions. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:LOAD:AUTO

This command defines which device setting is automatically loaded after the instrument is switched on.

Syntax: MMEMory:LOAD:AUTO 1,<file_name>
<file_name> ::= DOS file name without extension;
FACTORY denotes the data set previously in the instrument

Example: "MMEM:LOAD:AUTO 1,'C:\USER\DATA\TEST'"

Features: *RST value: -
SCPI: device-specific

The contents of the file are read after switching on the instrument and used to define the new device state. The file name includes indication of the path and may also include the drive. The path name corresponds to the DOS conventions. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:MDIRectory

This command creates a new directory.

Syntax: MMEMory:MDIRectory <directory_name>
<directory_name>::= DOS path name

Example: "MMEM:MDIR 'C:\USER\DATA'"

Features: *RST value: -
SCPI: device-specific

The file name includes indication of the path and may also include the drive. The path name corresponds to the DOS conventions. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:MOVE

This command renames existing files.

Syntax: MMEMory:MOVE <file_source>,<file_destination>
<file_source>,<file_destination> ::= <file_name>
<file_name> ::= DOS file name

Example: "MMEM:MOVE 'TEST01.CFG','SETUP.CFG'"

Features: *RST value: -
SCPI: conforming

The file name includes indication of the path and may also include the drive. The path name corresponds to the DOS conventions. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:MSIS

This command changes to the drive indicated.

Syntax: MMEMory:MSIS <device>
<device>::= 'A:' | 'C:'

Example: "MMEM:MSIS 'A:'"

Features: *RST value: 'C:'
SCPI: conforming

The drive may be the internal hard disk C: or the floppy-disk drive A:. The drive is indicated according to the DOS conventions.

MMEMory:NAME

This command specifies a file which is printed or plotted to.

Syntax: MMEMory:NAME <file_name>
<file_name> ::= DOS filename

Example: "MMEM:NAME 'PLOT1.HPG'"

Features: *RST value: -
SCPI: conforming

The file name includes indication of the path and may also include the drive. The file name and path information correspond to the DOS conventions. The output to the printer is routed into a file using the command "HCOP:DEST 'MMEM'".

MMEMory:RDIRectory

This command deletes the directory indicated.

Syntax: MMEMory:RDIRectory <directory_name>
<directory_name>::= DOS path name

Example: "MMEM:RDIR 'C:\TEST'"

Features: *RST value: -
SCPI: device-specific

The directory name includes indication of the path and may also include the drive. The path name corresponds to the DOS conventions. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:STORe:STATe

This command stores the current instrument setting in a file.

Syntax: MMEMory:STORe:STATe 1,<file_name>
<file_name> ::= DOS file name without extension

Example: "MMEM:STOR:STAT 1,'TEST'"

Features: *RST value: -
SCPI: conforming

The current instrument state is stored as a file. The file name includes indication of the path and may also include the drive. The path name corresponds to the DOS conventions. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:CLEar:STATe

This command deletes the instrument setting denoted by <file_name>.

Syntax: MMEMory:CLEar:STATe 1,<file_name>
<file_name> ::= DOS file name without extension

Example: "MMEM:CLE:STAT 1,'TEST'"

Features: *RST value: -
SCPI: device-specific

The device data set specified is deleted. The file name includes indication of the path and may also include the drive. The path name corresponds to the DOS conventions. This command is an event which is why it is not assigned an *RST value and has no query.

MMEMory:CLEar:ALL

This command deletes all instrument settings in the current directory.

Syntax: MMEMory:CLEar:ALL

Example: "MMEM:CLE:ALL"

Features: *RST value: -
SCPI: device-specific

This command is an "event" which is why it is not assigned an *RST value and has no query.

MMEMory:SELect[:ITEM]:GSETup

This command includes the data of the general setup in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:GSETup ON | OFF

Example: "MMEM:SEL:GSET ON"

Features: *RST value: OFF
SCPI: device-specific

MMEMory:SELect[:ITEM]:HWSettings

This command includes the hardware settings in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:HWSettings ON | OFF

Example: "MMEM:SEL:HWS ON"

Features: *RST value: ON
SCPI: device-specific

Level and frequency lines are stored with this command as well.

MMEMory:SELect[:ITEM]:TRACe<1 to 4>

This command includes the data of the selected trace in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:TRACe<1 to 4> ON | OFF

Example: "MMEM:SEL:TRACE3 ON"

Features: *RST value: OFF for all Traces
SCPI: device-specific

MMEMory:SELect[:ITEM]:LINes[:ACTive]

This command includes the active limit lines in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:LINes[:ACTive] ON | OFF

Example: "MMEM:SEL:LIN ON"

Features: *RST value: ON
SCPI: device-specific

Upon MMEM:LOAD the limit lines which are not currently active but contained in the data set are restored as well.

MMEMory:SELect[:ITEM]:LINes:ALL

This command includes all limit lines in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:LINes:ALL ON | OFF

Example: "MMEM:SEL:LIN:ALL ON"

Features: *RST value: ON
SCPI: device-specific

This command includes selection of the active limit lines.

MMEMory:SELect[:ITEM]:CSETup

This command includes the current color setting in the list of partial datasets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:CSETup ON | OFF

Example: "MMEM:SEL:CSET ON"

Features: *RST value: ON
SCPI: device-specific

MMEMory:SELect[:ITEM]:HCOPy

This command includes the hardcopy settings in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:HCOPy ON | OFF

Example: "MMEM:SEL:HCOPy ON"

Features: *RST value: ON
SCPI: device-specific

MMEMory:SELect[:ITEM]:MACRos

This command includes the keyboard macros in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:MACRos ON | OFF

Example: "MMEM:SEL:MACRos ON"

Features: *RST value: OFF
SCPI: device-specific

MMEMory:SELect[:ITEM]:SCData

This command includes the generator calibration data in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:SCData ON | OFF

Example: "MMEM:SEL:SCData ON"

Features: *RST value: OFF
SCPI: device-specific

This command only available in conjunction with the option Tracking Generator FSE-B8 to -B11

MMEMory:SELect[:ITEM]:TRANsducer[:ACTive]

This command includes the active transducer factors and set in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:TRANsducer[:ACTive] ON | OFF

Example: "MMEM:SEL:TRAN ON"

Features: *RST value: ON
SCPI: device-specific

Upon MMEM:LOAD the transducer factors and sets which are not currently active but contained in the data set are restored as well.

MMEMory:SELect[:ITEM]:TRANsducer:ALL

This command includes all transducer factors and sets in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:TRANsducer:ALL ON | OFF

Example: "MMEM:SEL:TRAN:ALL ON"

Features: *RST value: ON
SCPI: device-specific

This command is an event and therefore has no *RST value assigned.

MMEMory:SELect[:ITEM]:ALL

This command includes all data subsets in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:ALL

Example: "MMEM:SEL:ALL"

Features: *RST value: --
SCPI: device-specific

This command is an event and therefore has no *RST value assigned.

MMEMory:SELect[:ITEM]:NONE

This command deletes all data subsets in the list of data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:NONE

Example: "MMEM:SEL:NONE"

Features: *RST value: --
SCPI: device-specific

This command is an event and therefore has no *RST value assigned.

MMEMory:SELect[:ITEM]:DEFault

This command sets the default list of the data subsets of a device setting to be stored/loaded.

Syntax: MMEMory:SELect[:ITEM]:DEFault

Example: "MMEM:SEL:DEFault"

Features: *RST value: --
SCPI: device-specific

This command is an event and therefore has no *RST value assigned.

MMEMory:COMMent

This command defines a comment for a device setting to be stored.

Syntax: MMEMory:COMMent <string>

Example: "MMEM:COMM 'Setup for GSM measurement'"

Features: *RST value: blank comment
SCPI: device-specific

3.6.16 OUTPut Subsystem

The OUTPut subsystem checks the output features of the instrument.
In conjunction with option FSE-B8/B11, tracking generator, in the split screen mode, a distinction is made between OUTPut1 (screen A) and OUTPut2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
OUTPut<1|2>			
[:STATe]	<boolean>	--	Option FSE-B8 to B11
:UPORt<1|2>			
[:VALue]	<binary>	--	
:STATe	<boolean>	--	
:AF			
:SENSitivity	<numeric_value	PCT | HZ | KHZ | DEG | RAD	Vector Signal Analysis

OUTPut<1|2>[:STATe]

This command switches the tracking generator on or off.

Syntax: OUTPut:[:STATe] ON | OFF

Example: `"OUTP ON"`

Features: *RST value: -
SCPI: conforming

This command is only valid in conjunction with one of the options FSE-B8 to FSE-B11.

OUTPut:UPORt<1|2>[:VALue

This command sets the control lines of the user ports.

Syntax: OUTPut:UPORt<1|2>[:VALue] <binary>
<Binary>::= #B00000000 to #B11111111

Example: `"OUTP:UPOR2 #B10100101"`

Features: *RST value: -
SCPI: device-specific

User port 1 or 2 is written with the given binary pattern. If the user port is programmed to INPut instead of OUTPut, the output value is temporarily stored.

OUTPut:UPORt<1|2>:STATe

This command toggles the control lines of the user ports between INPut and OUTPut.

Syntax: OUTPut:UPORt<1|2>:STATe ON | OFF

Example: `"OUTP:UPOR:STAT ON"`

Features: *RST value: OFF
SCPI: device-specific

With ON, the user port is switched to OUTPut, with OFF to INPut.

OUTPut:AF:SENSitivity

This command changes the sensitivity of the AF-output.

Syntax: OUTPut:AF:SENSitivity <numeric_value>
<numeric_value> ::= 0.1 PCT to 100 PCT for AM
0.1 KHZ to 100 KHZ for FM
0.0 1RAD to 10 RAD for PM

Example: `"OUTP:AF:SENS 20PCT"`

Features: *RST value: 100 % for AM
100 kHz for FM
10 rad for PM
SCPI: device-specific

The command is only valid in the analog demodulation mode (Vector Signal Analysis, FSE-B7).

3.6.17 READ Subsystem

The READ-subsystem contains commands for starting complex measurement tasks such as those provided by options GSM BTS Analyzer (FSE-K11) or GSM MS Analyzer (FSE-K10), and for querying the results subsequently. The READ-subsystem is closely linked to the functions of the CONFigure- and FETCh-subsystems, where the measurement sequences are configured or the results are queried without restarting a new measurement.

3.6.17.1 READ:BURSt Subsystem

This subsystem provides the commands for starting measurements in the GSM BTS Analyzer mode (option FSE-K11), which are performed on individual bursts (carrier power, phase/frequency error), and for reading out the results subsequently.

COMMAND	PARAMETERS	UNIT	COMMENT
READ			
:BURSt			Option FSE-K11 or FSE-K10
:PERRor			
:RMS			
:AVERage?	--		query only
:MAXimum?	--		query only
:PEAK			
:AVERage?	--		query only
:MAXimum?	--		query only
:FERRor			
:AVERage?	--		query only
:MAXimum?	--		query only
:POWer?	--		
:STATic?	--		query only; FSE-K11 only
:DYNamic?	--		query only; FSE-K11 only
:LEVel?	--		query only; FSE-K10 only

READ:BURSt:PERRor:RMS:AVERage?

This command starts the measurement of the phase and frequency error of the base station or mobile and reads out the average of the RMS-measurement of the phase error taken over the selected number of bursts.

Syntax: READ:BURSt:PERRor:RMS:AVERage?

Example: "READ:BURS:PERR:RMS:AVER?"

Features: *RST value: --
SCPI: device-specific

When the measurement is started the instrument automatically assumes the SINGLE mode.

An ongoing measurement can be aborted via the command ABORt. Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the FETCh:BURSt-subsystem.

This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

READ:BURSt:PERRor:RMS:MAXimum?

This command starts the measurement of the phase and frequency error of the base station or mobile and reads out the maximum of the RMS-measurement of the phase error for the selected number of bursts.

Syntax: READ:BURSt:PERRor:RMS:MAXimum?

Example: "READ:BURS:PERR:RMS:MAX?"

Features: *RST value: --
SCPI: device-specific

When the measurement is started the instrument automatically assumes the SINGLE mode.
An ongoing measurement can be aborted via the command ABORt. Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the FETCh:BURSt-subsystem.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

READ:BURSt:PERRor:PEAK:AVERage?

This command starts the measurement of the phase and frequency error of the base station or mobile and reads out the maximum of the peak measurement of the phase error taken over the selected number of bursts.

Syntax: READ:BURSt:PERRor:PEAK:AVERage?

Example: "READ:BURS:PERR:PEAK:AVER?"

Features: *RST value: --
SCPI: device-specific

When the measurement is started the instrument automatically assumes the SINGLE mode.
An ongoing measurement can be aborted via the command ABORt. Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the FETCh:BURSt-subsystem.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

READ:BURSt:PERRor:PEAK:MAXimum?

This command starts the measurement of the phase and frequency error of the base station or mobile and reads out the maximum of the peak measurement of the phase error for the selected number of bursts.

Syntax: READ:BURSt:PERRor:PEAK:MAXimum?

Example: "READ:BURS:PERR:PEAK:MAX?"

Features: *RST value: --
SCPI: device-specific

When the measurement is started the instrument automatically assumes the SINGLE mode.
An ongoing measurement can be aborted via the command ABORt. Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the FETCh:BURSt-subsystem.
This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

READ:BURSt:FERRor:AVERage?

This command starts the measurement of the phase and frequency error of the base station or mobile and reads out the average of the frequency error taken over the selected number of bursts.

Syntax: READ:BURSt:FERRor:AVERage?

Example: "READ:BURS:FERR:AVER?"

Features: *RST value: --
SCPI: device-specific

When the measurement is started the instrument automatically assumes the SINGLE mode.

An ongoing measurement can be aborted via the command ABORt. Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the FETCh:BURSt-subsystem.

This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

READ:BURSt:FERRor:MAXimum?

This command starts the measurement of the phase and frequency error of the base station or mobile and reads out the maximum of the frequency error for the selected number of bursts.

Syntax: READ:BURSt:FERRor:MAXimum?

Example: "READ:BURS:FERR:MAX?"

Features: *RST value: --
SCPI: device-specific

When the measurement is started the instrument automatically assumes the SINGLE mode.

An ongoing measurement can be aborted via the command ABORt. Further results of the phase/frequency error measurement can be then queried without restart of the measurement via the FETCh:BURSt-subsystem.

This command is a query only and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the phase/frequency error is selected (see CONFigure:BURSt:PFERror).

READ:BURSt:POWer?

This command starts the measurement of the maximum output power of the base station or mobile and reads out the result.

Measurement of the maximum output power marks the beginning of a measurement cycle where subsequently the limits of the static and dynamic power control levels are checked step by step (`READ:BURSt:STATic?` or `READ:BURSt:DYNamic?`).

Syntax: READ:BURSt:POWer?

The result is read out as an ASCII string in the following format:

<Static Power Ctrl>,<Dyn Power Ctrl>,<Rat-Level>,<Act-Level>,
<Delta>,<Status>

<Static Power Ctrl>:	0
<Dyn Power Ctrl>:	0
<Rat-Level>:	rated value for the current power control level acc. to standard in dBm
<Act-Level>:	measured power in dBm
<Delta>:	0
<Status>:	result of limit check in character data form: PASSED no limits exceeded FAILED limit exceeded

Example: "READ:BURS:POW?"
Result: 0,0,43,44.1,0,PASSED

Features: *RST value: --
SCPI: device-specific

When the measurement is started any ongoing measurement cycle is aborted.
An ongoing measurement can be aborted with the command `ABORT`. This command is a query only and has therefore no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and when measurement of the maximum carrier power is selected (see `CONFigure:BURSt:POWer`).

READ:BURSt:POWer:STATic?

This command increases the static power control level for the measurement by one step, measures the output power of the base station and reads out the result.

If the command `READ:BURSt:POWer:STATic?` is repeated after the maximum static power control level is reached, the measurement sequence is terminated and the result of the maximum static power control level is read out again. In this case the value 'FINISHED' indicating the status is read out. Before the status value 'FINISHED' is read out, the value 'RUNNING' is output if the total result of the limit check is queried via `CALCulate<1|2>:LIMit<1 to 8>:BURSt:POWer?`.

Syntax: READ:BURSt:POWer:STATic?

The result is read out as an ASCII string in the following format:

<Static Power Ctrl>,<Dyn Power Ctrl>,<Rat-Level>,<Act-Level>,
<Delta>,<Status>

<Static Power Ctrl>:	current static power control level
<Dyn Power Ctrl>:	current dynamic power control level
<Rat-Level>:	rated value for the current power control level acc. to standard in dBm
<Act-Level>:	measured power in dBm
<Delta>:	difference between the measured power and the power at the previous static power control level.
<Status>:	result of the limit check in character data form:
	PASSED no limit exceeded
	FAILED limit exceeded
	FINISHED measurement sequence terminated

Example: "READ:BURS:POW:STAT?"
Result: 1,0,41,42.5,1.6,PASSED

Features: *RST value: --
SCPI: device-specific

The command `ABORt` terminates an ongoing measurement and resets the static and dynamic power control level to 0.
This command is only a query and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, and if measurement of the maximum carrier power is selected. (see `CONFigure:BURSt:POWer`).

READ:BURSt:POWer:DYNamic?

This command increases the dynamic power control level for the measurement by one step, measures the output power of the base station and reads out the result.

Once the maximum dynamic power control level is reached the command is accepted only after the static power control level is increased by one step.

Note that the command is no longer accepted after the measurement sequence is terminated which implies that the static power control level was read out again with `READ:BURSt:POWer:STATic?` after the maximum value was reached and marked with the 'FINISHED' status.

Syntax: READ:BURSt:POWer:DYNamic?

The result is read out as an ASCII string in the following format:

<Static Power Ctrl>,<Dyn Power Ctrl>,<Rat-Level>,<Act-Level>,
<Delta>,<Status>

<Static Power Ctrl>:	current static power control level
<Dyn Power Ctrl>:	current dynamic power control level
<Rat-Level>:	rated value for the current power control level acc. to standard in dBm
<Act-Level>:	measured power in dBm
<Delta>:	difference between the measured power and the power at the previous dynamic power control level.
<Status>:	result of the limit check in character data form:
	PASSED no limit exceeded
	FAILED limit exceeded

Example: "`READ:BURS:POW:DYN?`"
Result: `1,3,35,32.5,5.6,FAILED`

Features: *RST value: --
SCPI: device-specific

The command `ABORt` terminates an ongoing measurement and resets the static and dynamic power control level to 0.
This command is only a query and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, and if measurement of the maximum carrier power is selected. (see `CONFigure:BURSt:POWer`).

READ:BURSt:POWer:LEVel?

This command increases the power control level for the measurement by one step, measures the output power of the mobile and reads out the result.

Note that the command is no longer accepted after the measurement sequence is terminated which implies that the power control level was read out again with `READ:BURSt:POWer:LEVel?` after the maximum value was reached and marked with the 'FINISHED' status.

Syntax: READ:BURSt:POWer:LEVel?

The result is read out as an ASCII string in the following format:

<0>, <Power Ctrl Level>,<Rat-Level>,<Act-Level>, <Delta>,<Status>

<0>:	always 0 (this field is only significant for option FSE-K11)
<Power Ctrl Level>:	current power control level
<Rat-Level>:	rated value for the current power control level acc. to standard in dBm
<Act-Level>:	measured power in dBm
<Delta>:	difference between the measured power and the power at the previous power control level.
<Status>:	result of the limit check in character data form: PASSED no limit exceeded FAILED limit exceeded

Example: "READ:BURS:POW:LEV?"
Result: 0,3,35,32.5,5.6,FAILED

Features: *RST value: --
SCPI: device-specific

The command `ABORt` terminates an ongoing measurement and resets the power control level to 0. This command is only a query and therefore has no *RST value assigned. It is available only in conjunction with option GSM MS Analyzer, FSE-K10, and if measurement of the maximum carrier power is selected. (see `CONFigure:BURSt:POWer`).

3.6.17.2 READ:SPECtrum Subsystem

This subsystem provides the commands for starting measurements in the GSM BTS (option FSE-K11) and GSM MS (option FSE-K10) Analyzer mode, which are used to measure the power of the spectral components due to modulation and switching (modulation spectrum, transient spectrum), and for reading out the results subsequently.

COMMAND	PARAMETERS	UNIT	COMMENT
READ			
:SPECtrum			Option FSE-K11 or FSE-K10
:MODulation			
[:ALL?]	--		
:SWITching			
[:ALL?]	--		

READ:SPECtrum:MODulation[:ALL]?

This command starts the measurement of the modulation spectrum of the base station or mobile and reads out the result. The measurement is performed in the currently set frequency range.

Syntax: READ:SPECtrum:MODulation[:ALL]?

The result is read out as a list of partial ASCII result strings separated by ',' in the following format:

<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status> [,
<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status>]...

where the part set in '[...]' characterizes a partial result string which can be repeated n times.

<Index>: 0, if the partial result string characterizes a measurement range.
current number <>0, if the partial result string characterizes a single limit excess.

<Freq1>: Start frequency of the measurement range or frequency where the limit is exceeded.

<Freq2>: Stop frequency of the measurement range or frequency where the measured range is exceeded. The value of <Freq2> is equal to the value of <Freq1>, if either the measurement is performed in the time domain or the partial result string contains a limit excess.

<Level>: Measured maximum level of the partial range or measured level at the test point.

<Limit>: Limit in the partial range or at the test point.

<Abs/Rel>: ABS <Level> and <Limit> are in absolute units (dBm)
REL <Level> and <Limit> are in relative units (dBm)

<Status>: Result of the limit check in character data form:

PASSED	no limit exceeded
FAILED	limit exceeded
MARGIN	margin exceeded
EXC	limited excess characterized as an exception

The frequencies <Freq1> and <Freq2> are always absolute and not referred to the carrier frequency.

Example: "READ:SPEC:MOD?"
Result: 0,890E6,915E6,-87.4,-108.0,ABS,FAILED,
1,893.2E6,893.2E6,-83.2,-108.0,ABS,FAILED,
2,895.7E6,895.7E6,-87.4,-108.0,ABS,FAILED

Features: *RST value: --
SCPI: device-specific

The command ABORt aborts an ongoing measurement.
This command is only a query and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the modulation spectrum is selected. (see CONFigure:SPECtrum:MODulation).

READ:SPECtrum:SWITching[:ALL]?

This command starts the measurement of the transient spectrum of the base station or mobile and reads out the result.

Syntax: READ:SPECtrum:SWITching[:ALL]?

The result is read out as a list of partial ASCII result strings separated by ',' in the format used for READ:SPECtrum:MODulation[:ALL?].

Example: "READ:SPEC:SWIT?"
Result: 0,833.4E6,833.4E6,37.4,-36.0,ABS,MARGIN,
1,834.0E6,834.0E6,-35.2,-36.0,ABS,FAILED,
2,834.6E6,834.6E6,-74.3,-75.0,REL,FAILED
0,835.0E6,835.0E6,-65,0,-60.0,REL,PASSED

Features: *RST value: --
SCPI: device-specific

The command ABORt aborts an ongoing measurement.
This command is only a query and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the transient spectrum is selected. (see CONFigure:SPECtrum:SWITCHing).

3.6.17.3 READ:SPURious Subsystem

This subsystem provides the commands for starting measurements in the GSM BTS (option FSE-K11) and GSM MS (option FSE-K10) Analyzer mode, which are used to measure the power of spurious emissions, and for reading out the results subsequently.

COMMAND	PARAMETERS	UNIT	COMMENT
READ :SPURIOUS [:ALL?] :STEP?			Option FSE-K11 or FSE-K10

READ:SPURious[:ALL]?

This command starts the measurement of the spurious emissions of the base station or mobile and reads out the result. The measurement is performed in the currently set frequency range.

Syntax: READ:SPUR[:ALL]?

The result is read out as a list of partial ASCII result strings separated by ',' in the following format:

<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status> [,
<Index>,<Freq1>,<Freq2>,<Level>,<Limit>, <Abs/Rel>,<Status>]...

where the part set in '[...]' characterizes a partial result string which can be repeated n times.

<Index>: 0, if the partial result string characterizes a measurement range.
current number <>0, if the partial result string characterizes a single limit excess.

<Freq1>: Start frequency of the measurement range or frequency where the limit is exceeded.

<Freq2>: Stop frequency of the measurement range or frequency where the measured range is exceeded. The value of <Freq2> is equal to the value of <Freq1>, if either the measurement is performed in the time domain or the partial result string contains a limit excess.

<Level>: Measured maximum level of the partial range or measured level at the test point.

<Limit>: Limit in the partial range or at the test point.

<Abs/Rel>: ABS <Level> and <Limit> are in absolute units (dBm)
REL <Level> and <Limit> are in absolute units (dBm)

<Status>: Result of the limit check in character data form:
PASSED no limit exceeded
FAILED limit exceeded
MARGIN margin exceeded

Example: "READ:SPUR?"
Result:
```
0,890E6,915E6,-87.4,-108.0,ABS,FAILED,
1,893.2E6,893.2E6,-83.2,-108.0,ABS,FAILED,
2,895.7E6,895.7E6,-87.4,-108.0,ABS,FAILED
```

Features: *RST value: --
SCPI: device-specific

The command ABORt aborts an ongoing measurement.
This command is only a query and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the spurious emissions is selected. (see CONFigure:SPURious).

READ:SPURious:STEP?

This command starts the next single step for measuring the spurious emissions in the STEP mode and reads out the results. The measurement is performed in the currently set frequency range.

If the command READ:SPURious:STEP? is sent again after the last single step is reached, the measurement sequence is terminated, the result of the last single step is output again and characterized by the value 'FINISHED' indicating its status. Until the status value 'FINISHED' is returned, the value 'RUNNING' is output when the total result of the limit check is queried with the command CALCulate<1|2>:LIMit<1 to 8>:SPURious?.

Afterwards, sending the command again causes a restart of the measurement.

Syntax: READ:SPUR:STEP?

The measured result is read out as a list of partial result strings separated by ',' and in the same format as for the command READ:SPURious[:ALL?].
The additional status value 'FINISHED' marks the end of a measurement sequence.

Example: "READ:SPUR:STEP?"

Result:	First query:	0,890E6,915E6,-87.4,-108.0,ABS,FAILED
	...	
	Second-last query:	1,893.2E6,893.2E6,-83.2,-108.0,ABS,FAILED
	Last query:	1,893.2E6,893.2E6,-83.2,-108.0,ABS,FINISHED

Features: *RST value: --
SCPI: device-specific

The command ABORt aborts an ongoing measurement. If the command READ:SPURious:STEP? is sent again, the instrument restarts with the first single step.

This command is only a query and therefore has no *RST value assigned. It is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and if measurement of the spurious emissions is selected. (see CONFigure:SPURious).

3.6.18 SENSe Subsystem

The SENSe subsystem is itself divided up into several subsystems. The commands of these subsystems directly control device-specific settings, they do not refer to the signal characteristics of the measurement signal.
The SENSe subsystem controls the essential parameters of the analyzer and vector analyzer. In accordance with the SCPI standard, it is for this reason optional, which means that it is not necessary to include the SENSe node in command sequences.

3.6.18.1 SENSe:ADEMod Subsystem

This subsystem controls the parameters for analog demodulation. It is active only in conjunction with option Vector Signal Analysis, FSE-B7.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:ADEMod			option Vector Signal Analysis
:AF			
:COUPling	AC | DC		
:SQUelch			
[:STATe]	<Boolean>		
:LEVel	<numeric_value>	DBM	
:SBANd	NORMal | INVerse		
:RTIMe	<Boolean>		

[SENSe:]ADEMod:AF:COUPling

This command selects coupling of the AF-branch.

Syntax: [SENSe:]ADEMod:AF:COUPling AC | DC

Example: `"ADEM:AF:COUP DC"`

Features: *RST value: AC
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]ADEMod:SQUelch[:STATe]

This command switches the squelch for the audio branch on or off.

Syntax: [SENSe:]ADEMod:SQUelch ON | OFF

Example: `"ADEM:SQU ON"`

Features: *RST value: OFF
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]ADEMod:SQUelch:LEVel

This command defines the switching threshold for the squelch referred to the measured signal.

Syntax: [SENSe:]ADEMod:SQUelch <numeric_value>
<numeric_value> := 30 to -150 dBm

Example: "ADEM:SQU -10DBM"

Features: *RST value: -40dBm
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]ADEMod:SBANd

This command selects the side band for the demodulation.

Syntax: [SENSe:]ADEMod:SBANd NORMal | INVerse
NORMal = normal position
INVerse = inverse position

Example: "ADEM:SBAN INV"

Features: *RST value: NORMal
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]ADEMod:RTIMe

This command selects whether the demodulation performed in real time or in blocks.

Syntax: [SENSe:]ADEMod:RTIMe ON | OFF

Example: "ADEM:RTIM ON"

Features: *RST value: ON
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

3.6.18.2 [SENSe:]AVERage Subsystem

The [SENSe:]AVERage subsystem calculates the average of the data acquired. A new test result is obtained from various successive measurements. The amount of test points and the axis reference of the new result correspond to those of the original measurements.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:AVERage			
:COUNt	<numeric_value>	--	
:AUTO	<Boolean>	--	
[:STATe]	<Boolean>	--	
:TYPE	MAXimum | SCALar	--	

[SENSe:]AVERage:COUNt

The command specifies the number of measurements which are combined.

Syntax: [SENSe:]AVERage:COUNt <numeric_value>
<numeric value> ::= 0 to 32767

Example: ":AVER:COUN 16"

Features: *RST value: 0
SCPI: conforming

[SENSe:]AVERage:COUNt:AUTO

AUTO ON selects a suitable number of :COUNt for the respective type of measurement.

Syntax: [SENSe:]AVERage:COUNt:AUTO ON | OFF

Example: ":AVER:COUN:AUTO ON"

Features: *RST value: OFF
SCPI: conforming

[SENSe:]AVERage[:STATe]

The command switches on or off the average function.

Syntax: [SENSe:]AVERage[:STATe] ON | OFF

Example: ":AVER OFF"

Features: *RST value: OFF
SCPI: conforming

[SENSe:]AVERage:TYPE

The command selects the type of average function.

Syntax: [SENSe:]AVERage:TYPE MAXimum | SCALar

Example: ":AVER:TYPE SCAL"

Features: *RST value: SCALar
SCPI: conforming

The following average functions have been defined:

MAXimum: $AVG(n) = MAX(X_1 \text{ to } .X_n)$

SCALar: $$AVG(n) = \frac{1}{n} \times \sum_{i=1}^{n} xi$$

3.6.18.3 SENSe:BANDwidth Subsystem

This subsystem controls the setting of the analyzer's filter bandwidths. Both groups of commands (BANDwidth and BWIDth) perform the same functions.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:BANDwidth			
[:RESolution]	<numeric_value>	HZ	
:AUTO	<Boolean>	--	
:MODE	ANALog|DIGital	--	
:FFT	<Boolean>	--	option FFT Filter
:VIDeo	<numeric_value>	HZ	
:AUTO	<Boolean>	--	
:RATio	<numeric_value> | SINe | PULSe | NOISe	--	
:DEMod	<numeric_value>	HZ	option Vector Signal Analysis
:PLL	AUTO | HIGH | MEDium | LOW		
:BWIDth			
[:RESolution]	<numeric_value>	HZ	
:AUTO	<Boolean>	--	
:MODE	ANALog|DIGital	--	
:FFT	<Boolean>	--	option FFT Filter
:VIDeo	<numeric_value>	HZ	
:AUTO	<Boolean>	--	
:DEMod	<numeric_value>	HZ	option Vector Signal Analysis
:PLL	AUTO | HIGH | MEDium | LOW		

[SENSe:]BANDwidth|BWIDth[:RESolution]

This command defines the analyzer's resolution bandwidth.

Syntax: [SENSe:]BANDwidth|BWIDth[:RESolution] <numeric_value>
<numeric_value>::= 10 Hz to 10 MHz (model 20)
1 HZ to 10 MHz (model 30)

Example: `"BAND 1MHz"`

Features: *RST value: - (AUTO is set to ON)
SCPI: conforming

The values for the resolution bandwidth are rounded in 1 | 2 | 3 | 5 steps. Bandwidths >1kHz are always analog bandwidths, bandwidths <1kHz are always realized digitally. For the bandwidth 1kHz, it is possible to select either analog or digital filters.

In the GSM BTS/MS ANALYZER mode with option FSE-K11/K10, the command is available for POWER vs. TIME measurement. In this case, the parameters DEFault (bandwidth setting according to GSM standard), 300KHZ and 1MHZ are permitted.

[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO

This command either automatically couples the resolution bandwidth of the analyzer to the span or cancels the coupling.

Syntax: [SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO ON | OFF

Example: "BAND:AUTO OFF"

Features: *RST value: ON
SCPI: conforming

The automatic coupling matches the resolution bandwidth to the currently set span according to the relationship between span and resolution bandwidth.

[SENSe:]BANDwidth|BWIDth[:RESolution]:MODE

This command toggles between analog and digital resolution filters for the 1-kHz bandwidth.

Syntax: [SENSe:]BANDwidth|BWIDth[:RESolution]:MODE ANALog | DIGital

Example: "BAND:MODE DIG"

Features: *RST value: ANALog
SCPI: device-specific

Depending on the bandwidth, the resolution filters are automatically toggled between digital filters (<1kHz) and analog filters (>1kHz). The 1-kHz bandwidth is present in the instrument as a digital filter and as an analog filter and can be toggled using this command. If the analog filter is selected for the bandwidth 1kHz, the FFT-filtering for bandwidths ≤ 1kHz is switched off.

[SENSe:]BANDwidth|BWIDth[:RESolution]:MODE:FFT

This command toggles the digital filters used for bandwidths ≤ 1 kHz between ordinary mode and FFT-filter mode.

Syntax: [SENSe:]BANDwidth|BWIDth[:RESolution]:MODE:FFT ON | OFF

Example: "BAND:MODE:FFT ON"

Features: *RST value: OFF
SCPI: device-specific

The filter bandwidth of 1 kHz is switched to digital filtering for both ON and OFF. This command is only available in conjunction with option FFT Filter, FSE-B5.

[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio

This command defines the ratio resolution bandwidth (Hz) / span (Hz).

Syntax: [SENSe:]BANDwidth|BWIDth[:RESolution]:RATio <numeric_value>
<numeric_value>::= 0.0001 to 1

Example: "BAND:RAT 0.1"

Features: *RST value: -- (AUTO is set to ON)
SCPI: conforming

The ratio to be entered is reciprocal to the ratio Span/RBW used in manual control.

[SENSe:]BANDwidth|BWIDth:VIDeo

This command defines the analyzer's video bandwidth.

Syntax: [SENSe:]BANDwidth|BWIDth:VIDeo <numeric_value>
<numeric_value>::= 1Hz to 10MHz

Example: `"BAND:VID 10kHz"`

Features: *RST value: - (AUTO is set to ON)
SCPI: conforming

The values for the video bandwidth are rounded in 1 | 2 | 3 | 5 steps.

[SENSe:]BANDwidth|BWIDth:VIDeo:AUTO

This command either automatically couples the analyzer's video bandwidth to the resolution bandwidth or cancels the coupling.

Syntax: [SENSe:]BANDwidth|BWIDth:VIDeo:AUTO ON | OFF

Example: `"BAND:VID:AUTO OFF"`

Features: *RST value: ON
SCPI: conforming

[SENSe:]BANDwidth|BWIDth:VIDeo:RATIO

This command defines the ratio video bandwidth (Hz) / resolution bandwidth (Hz).

Syntax: [SENSe:]BANDwidth|BWIDth:VIDeo <numeric_value> | SINe | PULSe | NOISe
<numeric_value>::= 0.001 to 1000
The parameters SINe, PULSe and NOISe may be used as synonyms for the following values: SINe: 1 PULSe: 10 NOISe:0.1

Example: `"BAND:VID:RAT 10"`

Features: *RST value: - (AUTO is set to ON)
SCPI: conforming

The ratio to be entered is reciprocal to the ratio RBW/VBW used in manual control.

[SENSe:]BANDwidth|BWIDth:DEMod

This command defines the demodulation bandwidth of the analyzer for analog demodulation.

Syntax: [SENSe:]BANDwidth|BWIDth:DEMod <numeric_value>
<numeric_value>::= 5 kHz to 200 kHz (Real Time on)
5 kHz to 5 MHz (Real Time off)

Example: `"BAND:DEM 100KHZ"`

Features: *RST value: 10KHZ
SCPI: device-specific

The values for the demodulation bandwidth are rounded in steps of 1 | 2 | 3 | 5. The command is valid only in conjunction with option Vector Signal Analysis, FSE-B7, and for analog demodulation.

[SENSe:]BANDwidth|BWIDth:PLL

This command defines the bandwidth of the main PLL of the analyzer synthesizer.

Syntax: [SENSe:]BANDwidth|BWIDth:PLL AUTO|HIGH|MEDium|LOW

Example: `"BAND:PLL HIGH"`

Features: *RST value: AUTO
SCPI: device-specific

3.6.18.4 SENSe:CORRection-Subsystem

The SENSe:CORRection-subsystem controls the correction of measured results by means of frequency-dependent correction factors (e. g. for antenna or cable attenuation).
It also controls calibration and normalization during operation with the option tracking generator (FSE-B8 to FSE-B11).

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:CORRection			option Tracking Generator
:METHod	TRANsmission | REFLexion		
:COLLect			
[:ACQuire]	THRough | OPEN		no query
[:STATe]	<Boolean>		
:RECall			no query
:TRANsducer			
:SELect	<name>		
:UNIT	<string>		
:SCALing	LINear | LOGarithmic		
:DATA	<freq> , <level> ..	HZ , --	
[:STATe]	<Boolean>		
:DELete	--	--	no query
:TSET			
:SELect	<name>		
:UNIT	<string>		
:RANGe<1 to 10>	<freq> , <freq>, <name> ..	HZ, HZ, --	
[:STATe]	<Boolean>		
:DELete	--	--	no query
:LOSS			option FSE-K11 or FSE-K10
:INPut			
[:MAGNitude]	<numeric_value>	DB	
:RXGain			option FSE-K11
:INPut			
[:MAGNitude]	<numeric_value>	DB	

[SENSe:]CORRection[:STATe]

This command activates/deactivates normalization of the measurement results.

Syntax: [SENSe:]CORRection[:STATe] ON | OFF

Example: "CORR ON "

Features: *RST value: OFF
SCPI: conforming

This command is only valid in conjunction with option Tracking Generator, FSE-B8 to B12.

[SENSe:]CORRection:METHod

This command selects the kind of measurement with active tracking generator (transmission/reflexion).

Syntax: [SENSe:]CORRection:METHod TRANsmission | REFLexion

Example: `"CORR:METH TRAN "`

Features: *RST value: TRANsmission
SCPI: device specific

This command is only valid in conjunction with option Tracking Generator, FSE-B8 to B12.

[SENSe:]CORRection:COLLect[:ACQuire]

This command selects the kind of measurement for the reference values of the normalization (response calibration).

Syntax: [SENSe:] CORRection:COLLect[:ACQuire] THRough | OPEN

Example: `"CORR:COLL THR"`

Features: *RST value:
SCPI: conforming

THRough "TRANsmission" mode: calibration with direct connection between tracking generator and device input.
"REFLexion" mode: calibration with short circuit at the input

OPEN only valid in "REFLexion" mode:calibration with open input

This command is an event which is why it is not assigned an *RST value an a query. It is only valid in conjunction with option Tracking Generator, FSE-B8 to B12.

[SENSe:]CORRection:RECall

This command restores the instrument setting that was valid for the measurement of the reference data. It is only valid in conjunction with option Tracking Generator, FSE-B8 to B12.

Syntax: [SENSe:] CORRection:RECall

Example: `"CORR:REC"`

Features: *RST value: -
SCPI: conforming

This command is an event which is why it is not assigned an *RST value and a query. It is only valid in conjunction with option Tracking Generator, FSE-B8 to B12.

[SENSe:]CORRection:TRANsducer:SELect

This command selects the transducer factor designated by <name>. If <name> does not exist yet, a new transducer factor is created.

Syntax: [SENSe:]CORRection:TRANsducer:SELect <name>
<name>::= Name of the transducer factor in string data form with a maximum of 8 characters.

Example: `"CORR:TRAN:SEL 'FACTOR1'"`

Features: *RST value: -
SCPI: device-specific

This command must be sent prior to the subsequent commands for modifying/activating transducer factors.

[SENSe:]CORRection:TRANsducer:UNIT

This command defines the unit of the transducer factor selected.

Syntax: [SENSe:]CORRection:TRANsducer:UNIT <string>
<string>::= 'DB' | 'DBM' | 'DBMV' | 'DBUV' | 'DBUV/M' | 'DBUA' 'DBUA/M' | 'DBPW' | 'DBPT'

Example: `"CORR:TRAN:UNIT 'DBUV'"`

Features: *RST value: 'DB'
SCPI: device-specific

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

[SENSe:]CORRection:TRANsducer:SCALing

This command defines whether the frequency scaling of the transducer factor is linear or logarithmic.

Syntax: [SENSe:]CORRection:TRANsducer:SCALing LINear|LOGarithmic

Example: `"CORR:TRAN:SCAL LOG"`

Features: *RST value: LINear
SCPI: device-specific

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

[SENSe:]CORRection:TRANsducer:DATA

This command defines the test points for the selected transducer factor. The values are entered as a series of frequency/level pairs. The frequencies must be in ascending order.

Syntax: [SENSe:]CORRection:TRANsducer:DATA <freq>,<level>..

Example: `"CORR:TRAN:TRANsducer:DATA 1MHZ,-30,2MHZ,-40"`

Features: *RST value: -
SCPI: device-specific

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent. The level values are sent as dimensionless numbers; the unit is specified by means of the command `SENS:CORR:TRAN:UNIT`.

[SENSe:]CORRection:TRANsducer[:STATe]

This command switches the selected transducer factor on or off.

Syntax: [SENSe:]CORRection:TRANsducer[:STATe] ON | OFF

Example: `"CORR:TRAN ON"`

Features: *RST value: OFF
SCPI: device-specific

Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

[SENSe:]CORRection:TRANsducer:DELete

This command deletes the selected transducer factor.

Syntax: [SENSe:]CORRection:TRANsducer:DELete

Example: `"[SENSe:]CORR:TRAN:DEL"`

Features: *RST value: -
SCPI: device-specific

This command is an event and therefore has no *RST value.
Prior to this command, the command `SENS:CORR:TRAN:SEL` must be sent.

[SENSe:]CORRection:TSET:SELect

This command selected the transducer set designated by <name>. If <name> does not exist yet, a new set is created.

Syntax: [SENSe:]CORRection:TSET:SELect <name>
<name>::= name of the transducer set in string data form with a maximum of 8 characters.

Example: `"CORR:TSET:SEL 'SET1'"`

Features: *RST value: -
SCPI: device-specific

This command must be sent prior to the subsequent commands for changing/activating the transducer sets.

[SENSe:]CORRection:TSET:UNIT

This command defines the unit of the selected transducer sets. When assigning transducer factors to the set, only factors which are compatible to the selected unit, i. e. factors with the same unit or the unit dB, are allowed.

Syntax: [SENSe:]CORRection:TSET:UNIT <string>
<string>::= 'DB' | 'DBM' | 'DBUV' | 'DBUV/M' | 'DBUA' 'DBUA/M" | DBPW' | 'DBPT'

Example: `"CORR:TSET:UNIT 'DBUV'"`

Features: *RST value: 'DB'
SCPI: device-specific

Prior to this command, the command `SENS:CORR:TSET:SEL` must be sent.

[SENSe:]CORRection:TSET:RANGe<1 to 10>

This command defines a partial range of the selected transducer set. The partial range is determined by its start and stop frequencies plus a list of names of the assigned transducer factors. The ranges 1 to 10 must be sent in ascending order.

Syntax: [SENSe:]CORRection:TSET:RANGe<1 to 10> <freq>,<freql>,<name>..
<freq>,<freq>::= start frequency, stop frequency of the range
<name>...::= list of names for the assigned transducer factors. The individual names must be characterized by single quotation marks (') and separated by commas.

Example: `"CORR:TRAN:TSET:RANG 1MHZ,2MHZ,'FACTOR1,'FACTOR2'"`

Features: *RST value: -
SCPI: device-specific

Prior to this command, the command `SENS:CORR:TSET:SEL` must be sent.

[SENSe:]CORRection:TSET[:STATe]

This command switches the selected transducer set on or off.

Syntax: [SENSe:]CORRection:TSET[:STATe] ON | OFF

Example: `"CORR:TSET ON"`

Features: *RST value: OFF
SCPI: device-specific

Prior to this command, the command `SENS:CORR:TSET:SEL` must be sent.

[SENSe:]CORRection:TSET:DELete

This command deletes the selected transducer set.

Syntax: [SENSe:]CORRection:TSET:DELete

Example: "[SENSe:]CORR:TSET:DEL"

Features: *RST value: -
SCPI: device-specific

This command is an event and thus has no *RST value assigned.
Prior to this command, the command SENS:CORR:TSET:SEL must be sent.

[SENSe:]CORRection:LOSS:INPut[:MAGNitude]

This command announces to the instrument a possibly needed external attenuation of the input signal, so that it is taken into account later when the level is set.

Syntax: [SENSe:]CORRection:LOSS:INPut[:MAGNitude] <numeric_value>
with <numeric_value>::= value of external attenuation in dB.

Example: "[SENSe:]CORR:LOSS:INP 30DB "

Features: *RST value: 20dB
SCPI: device-specific

The external attenuation must be selected such that the input power of the analyzer does not exceed 27 dBm.
The command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

[SENSe:]CORRection:RXGain:INPut[:MAGNitude]

This command announces to the instrument a possibly needed preamplification in the RX-band (RX BAND GAIN), so that it is taken into account later when the measured values are read out.

Syntax: [SENSe:]CORRection:RXGain:INPut[:MAGNitude] <numeric_value>
with <numeric_value>::= value of the amplification in dB.

Example: "[SENSe:]CORR:RXG:INP 30DB "

Features: *RST value: 0 dB
SCPI: device-specific

The command is available only in conjunction with options GSM BTS/MS Analyzer, FSE-K11/K10, and for spurious emission or modulation spectrum measurement (K11 only).

3.6.18.5 SENSe:DETector Subsystem

The SENSe:DETector subsystem controls the recording of measurement values via the type of detector selected for each trace.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:DETector			
[:FUNCtion]	APEak | NEGative| POSitive | SAMPle| RMS | AVERage	--	
:AUTO	<Boolean>		

[SENSe:]DETector[:FUNCtion]

This command switches the detector for recording of the measured value.

Syntax: [SENSe:]DETector[:FUNCtion] APEak INEGative I POSitive I SAMPle I RMS I AVERage

Example: "DET POS"

Features: *RST value: APEak
SCPI: conforming

The value "APEak" (AutoPeak) displays both the positive peak value and the negative peak value when noise is present. The positive peak value is displayed when one signal is present.

[SENSe:]DETector[:FUNCtion]:AUTO

This command either couples the detector to the current trace setting or turns coupling off.

Syntax: [SENSe:]DETector[:FUNCtion]:AUTO ON I OFF

Example: "DET:AUTO OFF"

Features: *RST value: ON
SCPI: conforming

3.6.18.6 SENSe:DDEMod Subsystem

This subsystem controls the parameters for digital demodulation and is only active in conjunction with operating mode Vector Signal Analysis (option FSE-B7).

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:DDEMod			Vector Signal Analysis
:FORMat	QPSK | PSK | MSK | QAM | FSK		
:SBANd	NORMal | INVerse		
:QPSK			
:FORMat	NORMal | DIFFerential | OFFSet | DPI4		
:PSK			
:NSTate	2 | 8		
:FORMat	NORMal | DIFFerential		
:MSK			
:FORMat	TYPE1 | TYPE2 | NORMal | DIFFerential		
:QAM			
:NSTate	16		
:FSK			
:NSTate	2 | 4		
:SRATe	<numeric_value>	HZ	
:TIMe	<numeric_value>	SYM	
:PRATe	1 | 2 | 4 | 8 | 16		
:FILTer			
:MEASurement	OFF | RCOSine | RRCosine | GAUSsian		
:REFerence	RCOSine | RRCosine | GAUSsian		
:ALPHa	<numeric_value>		
:NORMalize	<Boolean>		
:PRESet	GSM | TETRa | DCS1800 | PCS1900 | PHS | PDCup | PDCDown | APCO25CQPSK | APCO25C4FM | CDPD | DECT | CT2 | ERMes | MODacom | PWT | TFTS | F16 | F322 | F324 | F64 | FQCDma | RQCDma | FNADc | RNADc		
:SEARch			
:PULSe			
:STATe	<Boolean>		
:SYNC			
:OFFSet	<numeric_value>	SYM	
:PATTern	<string>		
:STATe	<Boolean>		
:TIME	<numeric value>	SYM	
:TCAPture			Vector Signal Analysis
:LENGth	<numeric_value>		

[SENSe:]DDEMod:FORMat

This command selects the digital demodulation type.

Syntax: [SENSe:]DDEMod:FORMat QPSK | PSK | MSK | QAM | FSK

Example: "DDEM:FORM QPSK"

Features: *RST value: MSK
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:SBANd

This command selects the sideband for the demodulation.

Syntax: [SENSe:]DDEMod:SBANd NORMal | INVerse
NORMal = normal position
INVerse = inverse position

Example: "DDEM:SBAN INV"

Features: *RST value: NORMal
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:QPSK:FORMat

This command determines the specific demodulation type for QPSK.

Syntax: [SENSe:]DDEMod:QPSK:FORMat NORMal | DIFFerential | OFFSet | DPI4

Example: "DDEM:QPSK:FORM DPI4"

Features: *RST value: -
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:PSK:NSTate

This command determines the specific demodulation type for PSK.

Syntax: [SENSe:]DDEMod:PSK:NSTate 2 | 8

Example: "DDEM:PSK:NST 2"

Features: *RST value: -
SCPI: device-specific

Value 2 (i.e. PSK2) corresponds to BPSK demodulation, value 8 the 8PSK demodulation. This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:PSK:FORMat

This command determines the specific demodulation type for PSK.

Syntax: [SENSe:]DDEMod:PSK:FORMat NORMal | DIFFerential

Example: "DDEM:PSK:FORM DIFF"

Features: *RST value: -
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:MSK:FORMat

This command determines the specific demodulation type for MSK.

Syntax: [SENSe:]DDEMod:MSK:FORMat TYPE1 | TYPE2 | NORMal | DIFFerential

Example: `"DDEM:MSK:FORM TYPE2"`

Features: *RST value: TYPE2 | DIFFerential
SCPI: device-specific

`TYPE1 | NORMal` corresponds to MSK demodulation, `TYPE2 | DIFFerential` corresponds to DMSK demodulation. This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:QAM:NSTate

This command determines the specific demodulation type for QAM.

Syntax: [SENSe:]DDEMod:QAM:NSTate 16

Example: `"DDEM:QAM:NST 16"`

Features: *RST value: 16
SCPI: device-specific.

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:FSK:NSTate

This command determines the specific demodulation type for FSK.

Syntax: [SENSe:]DDEMod:FSK:NSTate 2 | 4

Example: `"DDEM:FSK:NST 2"`

Features: *RST- value: -
SCPI: device-specific

The parameter 2 corresponds to the demodulation type 2FSK, the parameter 4 to the demodulation type 4FSK.This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:SRATe

This command defines the symbol rate.

Syntax: [SENSe:]DDEMod:SRATe <numeric_value>
<numeric value> ::= 160 Hz to 1.6 MHz

Example: `"DDEM:SRAT 18kHz"`

Features: *RST value: 270.833333kHz
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:TIME

The command determines the number of displayed symbols (result length).

Syntax: [SENSe:]DDEMod:TIME <numeric_value>
<numeric value> ::= 1 to Frame Length

Example: `"DDEM:TIME 80"`

Features: *RST value: 147
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:PRATe

This command determines the number of points per symbol.

Syntax: [SENSe:]DDEMod:PRATe 1 | 2 | 4 | 8 | 16

Example: "DDEM:PRAT 8"

Features: *RST value: 4
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:FILTer:MEASurement

This command selects the input filter for the test signal.

Syntax: [SENSe:]DDEMod:FILTer:MEASurement
OFF | RCOSine | RRCosine | GAUSsian

Example: "DDEM:FILT:MEAS RCOS"

Features: *RST value: OFF
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:FILTer:REFerence

This command selects the input filter for the reference signal.

Syntax: [SENSe:]DDEMod:FILTer:REFerence
RCOSine | RRCosine | GAUSsian

Example: "DDEM:FILT:REF RCOS"

Features: *RST value: GAUSsian
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:FILTer:ALPHa

This command determines the filter characteristic (ALPHA/BT).

Syntax: [SENSe:]DDEMod:FILTer:ALPHa <numeric_value>
<numeric_value>::= 0.2 to 1 (step width 0.05)

Example: "DDEM:FILT:ALPH 0.5"

Features: *RST value: 0.3
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:NORMalize

This command switches normalizing of the unit circle on or off using IQ offset.

Syntax: [SENSe:]DDEMod:NORMalize ON | OFF

Example: "DDEM:NORM OFF"

Features: *RST value: ON
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:SEARch:PULSe:STATe

This command switches the signal burst search on or off.

Syntax: [SENSe:]DDEMod:SEARch:PULSe:STATe ON | OFF

Example: "DDEM:SEAR:PULS:STAT OFF"

Features: *RST value: ON
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:SEARch:SYNC:OFFSet

This command defines the offset of the display with reference to the synchronization sequence.

Syntax: [SENSe:]DDEMod:SEARch:SYNC:OFFSET <numeric_value>

Example: "DDEM:SEAR:SYNC:OFFS 10SYM"

Features: *RST value: 0 SYM
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:SEARch:SYNC:PATTern

This command defines the synchronization sequence.

Syntax: [SENSe:]DDEMod:SEARch:SYNC:PATTern <string>

Example: "DDEM:SEAR:SYNC:PATT "1101001"

Features: *RST value: ""
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:SEARch:SYNC:STATe

This command switches the search for a synchronization sequence on or off.

Syntax: [SENSe:]DDEMod:SEARch:SYNC:STATe ON | OFF

Example: "DDEM:SEARch:SYNC:STAT ON"

Features: *RST value: OFF
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:SEARch:TIME

This command determines the number of symbols required for demodulation (frame length). The values > 800 are only permissible if the number of points per symbol is <16, the values > 1600 only if the number of points per symbol is <8.

Syntax: [SENSe:]DDEMod:SEARch:TIME 100 to 1600 (step width = 100)

Example: `"DDEM:SEAR:TIME 800"`

Features: *RST value: 400
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]DDEMod:PRESet

This command selects an automatic setting of all modulation parameters according to a standard transmission method.

Syntax: [SENSe:]DDEMod:PRESet GSM | TETRa | DCS1800 | PCS1900 | PHS | PDCup | PDCDown | APCO25CQPSK | APCO25C4FM | CDPD | DECT | CT2 | ERMes | MODacom | PWT | TFTS | F16 | F322 | F324 | F64 | FQCDma | RQCDmal FNADc | RNADc

Example: `"DDEM:PRES TETR"`

Features: *RST value: GSM
SCPI: device-specific

FQCDma	Forward CDMA according to IS95 standard
RQCDma	Reverse CDMA according to IS95 standard
F16	FLEX 1600 - 2FSK
F322	FLEX 3200 - 2FSK
F324	FLEX 3200 - 4FSK
F64	FLEX 6400 - 4FSK

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

[SENSe:]TCAPture:LENGth

This command determines the number of sampling points that are written into the memory for each measurement (memory size).

Syntax: [SENSe:]TCAPture:LENGth 1024 | 2048 | 4096 | 8192 | 16384

Example: `"TCAP:LENG 1024"`

Features: *RST value: 16384
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for digital demodulation.

3.6.18.7 SENSe:FILTer Subsystem

The SENSe:FILTer subsystem selects the filters in the video signal path. This subsystem is active only in the Vector Signal Analysis mode (option FSE-B7).

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:FILTer			Vector Signal Analyzer
:HPASs			
[:STATe]	<Boolean>	--	
:FREQuency	<numeric_value>	HZ	
:LPASs			Vector Signal Analyzer
[:STATe]	<Boolean>	--	
:FREQuency	<numeric_value>	HZ | PCT	
:CCITt			
[:STATe]	<Boolean>	--	
:CMESsage			
[:STATe]	<Boolean>	--	
:DEMPhasis			
[:STATe]	<Boolean>		
:TCONstant	<numeric_value>	S	
:LINK	DISPlay | AUDio		

[SENSe:]FILTer:HPASs[:STATe]

This command activates the high-pass filter in the AF-branch for analog demodulation.

Syntax: [SENSe:]FILTer:HPASS[:STATe] ON | OFF

Example: `"FILT:HPAS ON"`

Features: *RST value: OFF
SCPI: conforming

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]FILTer:HPASs:FREQuency

In the Vector Signal Analysis mode with analog demodulation, this command defines the frequency limit of the high-pass filter in the AF-branch. For REAL TIME ON absolute frequencies are entered, for REAL TIME OFF, the frequencies are entered relative to the demodulation bandwidth.

Syntax: [SENSe:]FILTer:HPASs:FREQuency <numeric_value>
<numeric_value> ::= 10 Hz | 100 Hz | 1 kHz | 1 MHz (signal analysis)
30 Hz | 300 kHz (vector signal analysis)

Example:
```
"FILT:HPAS:FREQ 100HZ"
"FILT:HPAS:FREQ 30HZ"
```

Features: *RST value: - (STATe = OFF)
SCPI: conforming

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]FILTer:LPASs[:STATe]

This command activates the low-pass filter in the AF-branch with analog demodulation.

Syntax: [SENSe:]FILTer:LPASS[:STATe] ON | OFF

Example: "FILT:LPAS ON"

Features: *RST value: OFF
SCPI: conforming

On switching to ON, a bandwidth of 3 kHz for REAL TIME ON and a bandwidth of 5 PCT for REAL TIME OFF is set automatically. This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]FILTer:LPASs:FREQuency

This command defines the frequency limit of the low-pass filter in the NF-branch for analog demodulation.

Syntax: [SENSe:]FILTer:LPASs:FREQuency <numeric_value>
<numeric_value> ::= 3 kHz | 15 kHz bei REAL TIME ON
5 PCT | 10 PCT | 25 PCT bei REAL TIME OFF

Example: "FILT:LPAS:FREQ 3KHZ" for REAL TIME ON
"FILT:LPAS:FREQ 25PCT" for REAL TIME OFF

Features: *RST value: - (STATe = OFF)
SCPI: conforming

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]FILTer:CCITt[:STATe]

This command activates the weighting filter according to CCITT-recommendation in the AF-branch for analog demodulation.

Syntax: [SENSe:]FILTer:CCITt[:STATe] ON | OFF

Example: "FILT:CCIT ON"

Features: *RST value: OFF
SCPI: conforming

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]FILTer:CMESsage[:STATe]

This command activates the C-message weighting filter according to CCITT-recommendation in the AF-branch for analog demodulation.

Syntax: [SENSe:]FILTer:CMESsage[:STATe] ON | OFF

Example: "FILT:CMES ON"

Features: *RST value: OFF
SCPI: conforming

This command is valid only in the Vector Signal Analysis mode and for analog demodulation with REAS TIME OFF.

[SENSe:]FILTer:DEMPhasis[:STATe]

This command activates the selected de-emphasis for analog demodulation.

Syntax: [SENSe:]FILTer:DEMPhasis[:STATe] ON | OFF

Example: `"FILT:DEMP ON"`

Features: *RST value: OFF
SCPI: conforming

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]FILTer:DEMPhasis:TCONstant

This command sets the time constant of the de-emphasis for analog demodulation.

Syntax: [SENSe:]FILTer:DEMPhasis:TCONstant 50US | 75US | 750US

Example: `"FILT:DEMP:TCON 75US"`

Features: *RST value: 50us
SCPI: conforming

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]FILTer:DEMPhasis:LINK

For analog demodulation, this command selects whether the de-emphasis set is to be active in the audio branch only or in addition for the display of measured values.

Syntax: [SENSe:]FILTer:DEMPhasis:LINK DISPlay | AUDio
AUDio::= De-emphasis effective in the audio branch only
DISPlay::= De-emphasis effective in the audio branch and in the display of measured values

Example: `"FILT:DEMP:LINK DISP"`

Features: *RST value: AUDio
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

3.6.18.8 SENSe:FREQuency Subsystem

The SENSe:FREQuency subsystem defines the frequency axis of the active display. The frequency axis can either be defined via the start/stop frequency or via the center frequency and span.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:FREQuency			
:CENTer	<numeric_value>	HZ	
:LINK	STARt | STOP | SPAN	--	
:STEP	<numeric_value>	HZ	
:LINK	SPAN | RBW | OFF	--	
:FACTor	<numeric_value>	PCT	
:SPAN	<numeric value>	HZ	
:FULL	--	--	
:LINK	CENTer | STARt | STOP	--	
:STARt	<numeric_value>	HZ	
:LINK	CENTer | STOP | SPAN	--	
:STOP	<numeric_value>	HZ	
:LINK	CENTer | STAR t |SPAN	--	
:MODE	CW | FIXed | SWEep	--	
:OFFSet	<numeric_value>	HZ	

[SENSe:]FREQuency:CENTer

This command defines the center frequency of the analyzer.

Syntax: [SENSe:]FREQuency:CENTer <numeric_value>
<numeric_value>::= 0 GHz to f_{max}

Example: `"FREQ:CENT 100MHz"`

Features: *RST value: f_{max} / 2
SCPI: conforming

The automatic coupling of the parameters is set to SPAN FIXED.

[SENSe:]FREQuency:CENTer:LINK

This command defines the coupling of the center frequency to the start, stop frequency or the frequency span.

Syntax: [SENSe:]FREQuency:CENTer:LINK STARt | STOP | SPAN

Example: `"FREQ:CENT:LINK STAR"`

Features: *RST value: SPAN
SCPI: device-specific

[SENSe:]FREQuency:CENTer:STEP

This command defines the step width of the center frequency.

Syntax: [SENSe:]FREQuency:CENTer:STEP <numeric_value>
<numeric_value>::= 0 to f_{max}

Example: `"FREQ:CENT:STEP 120MHz"`

Features: *RST value: - (AUTO 0.1 × SPAN is switched on)
SCPI: conforming

[SENSe:]FREQuency:CENTer:STEP:LINK

This command couples the step width of the center frequency to span (span >0) or to the resolution bandwidth (span = 0) or cancels the couplings.

Syntax: [SENSe:]FREQuency:CENTer:STEP:LINK SPAN | RBW | OFF

Example: `"FREQ:CENT:STEP:LINK SPAN"`

Features: *RST value: SPAN
SCPI: device-specific

[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor

This command couples the step width of the center frequency with a factor to the span (span >0) or to the resolution bandwidth (span = 0).

Syntax: [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <numeric_value>
<numeric_value>::= 1 to 100 PCT

Example: `"FREQ:CENT:STEP:LINK:FACT 20PCT"`

Features: *RST value: - (AUTO 0.1 × SPAN is switched on)
SCPI: device-specific

[SENSe:]FREQuency:SPAN

This command defines the frequency span of the analyzer.

Syntax: [SENSe:]FREQuency:SPAN <numeric_value>
<numeric_value>::= 0 GHz to f_{max}

Example: `"FREQ:SPAN 10MHz"`

Features: *RST value: f_{max}
SCPI: conforming

The automatic coupling of the parameters is set to CENTER FIXED.

[SENSe:]FREQuency:SPAN:FULL

This command sets the maximum frequency span of the analyzer.

Syntax: [SENSe:]FREQuency:SPAN:FULL

Example: "FREQ:SPAN:FULL"

Features: *RST value: -
SCPI: conforming

This command is an event which is why it is not assigned an *RST value and has no query.

[SENSe:]FREQuency:SPAN:LINK

This command defines the coupling for frequency-span changes.

Syntax: [SENSe:]FREQuency:SPAN:LINK CENTer | START | STOP

Example: "FREQ:SPAN:LINK STOP"

Features: *RST value: CENTer
SCPI: conforming

[SENSe:]FREQuency:STARt

This command defines the start frequency of the analyzer.

Syntax: [SENSe:]FREQuency:STARt <numeric_value>
<numeric_value>::= 0 GHz to f_{max}

Example: "FREQ:STAR 20MHz"

Features: *RST value: 0
SCPI: conforming

The automatic coupling of the parameters is set to STOP FIXED.

[SENSe:]FREQuency:STARt:LINK

This command defines the coupling for start-frequency changes.

Syntax: [SENSe:]FREQuency:STARt:LINK CENTer | STOP | SPAN

Example: "FREQ:STAR:LINK SPAN"

Features: *RST value: STOP
SCPI: device-specific

[SENSe:]FREQuency:STOP

This command defines the stop frequency of the analyzer.

Syntax: [SENSe:]FREQuency:STOP <numeric_value>
<numeric_value>::= 0 GHz to f_{max}

Example: `"FREQ:STOP 2000MHz"`

Features: *RST value: f_{max}
SCPI: conforming

The automatic coupling of the parameters is set to STARt FIXED.

[SENSe:]FREQuency:STOP:LINK

This command defines the coupling for stop-frequency changes.

Syntax: [SENSe:]FREQuency:STOP:LINK CENTer | STARt | SPAN

Example: `"FREQ:STOP:LINK SPAN"`

Features: *RST value: STARt
SCPI: device-specific

[SENSe:]FREQuency:MODE

This command determines which command groups are used for setting the frequency of the analyzer.

Syntax: [SENSe:]FREQuency:MODE CW | FIXed | SWEep

Example: "FREQ:MODE SWE"

Features: *RST value: SWE
SCPI: conforming

For CW and FIXed, the frequency setting is via command `FREQuency:CW`. In the SWEep mode, the setting is via commands `FREQuency:STARt`, `STOP`, `CENTer` and `SPAN`.

[SENSe:]FREQuency:OFFSet

This command defines the frequency offset of the analyzer.

Syntax: [SENSe:]FREQuency:OFFSet <numeric_value>

Example: `"FREQ:OFFS 1GHZ"`

Features: *RST value: 0 Hz
SCPI: conforming

3.6.18.9 SENSe:MSUMmary Subsystem

This subsystem controls the modulation summary setting for analog demodulation. It is active only in conjunction with option Vector Analysis, FSE-B7.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:MSUMmary			Vector Signal Analysis
:AHOLd			
[:STATe]	<Boolean>		
:MODE	ABSolute | RELative		
:REFerence	<numeric_value>	PCT | HZ | DEG | RAD	
:AUTO	ONCE		no query
:MTIMe	<numeric_value>	S	

[SENSe:]MSUMmary:AHOLd[:STATe]

This command switches on the average/peak hold mode.

Syntax: [SENSe:]MSUMmary:AHOLd[:STATe]ON | OFF

Example: "MSUM:AHOL ON"

Features: *RST value: OFF
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]MSUMmary:MODE

This command selects the absolute or relative indication of the summary marker values.

Syntax: [SENSe:]MSUMmary:MODE ABSolute | RELative

Example: "MSUM:MODE REL"

Features: *RST value: ABSolute
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]MSUMmary:REFerence

This command selects the reference modulation.

Syntax: [SENSe:]MSUMmary:REFerence <numeric_value>
<numeric_value> :=
0.001PCT to 1000PCT for AM
0.1HZ to 10MHZ for FM
0.0001RAD to 1000RAD for PM

Example: "MSUM:REF 50PCT"

Features: *RST value: 100PCT for AM
100KHZ for FM
10RAD for PM
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]MSUMmary:REFerence:AUTO

This command sets the current absolute measured values of the main modulation signal as reference values for the relative indication.

Syntax: [SENSe:]MSUMmary:REFerence:AUTO ONCE

Example: `"MSUM:REF:AUTO ONCE"`

Features: *RST value: --
SCPI: device-specific

This command is an event and has therefore no query and no *RST value assigned. This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

[SENSe:]MSUMmary:MTIMe

This command selects the measurement time for the summary markers.

Syntax: [SENSe:]MSUMmary:MTIMe <numeric_value>
<numeric_value> := 0.1 s | 1 s

Example: `"MSUM:MTIM 100US"`

Features: *RST value: 0.1S
SCPI: device-specific

This command is valid only in the Vector Signal Analysis mode and for analog demodulation.

3.6.18.10 SENSe:POWer Subsystem

This subsystem controls the setting of the analyzer's power measurements.

COMMAND	PARAMETER	UNIT	COMMENT
[SENSe<1|2>]			
:POWer			
:ACHannel			
:SPACing			
[:UPPer]	<numeric_value>	HZ	
:ACPairs	1 | 2 | 3		
:BANDwidth			
[:CHANnel]	<numeric_value>	HZ	
:ACHannel	<numeric_value>	HZ	
:ALTernate<1|2>	<numeric_value>	HZ	
:BWIDth			
[:CHANnel]	<numeric_value>	HZ	
:ACHannel	<numeric_value>	HZ	
:ALTernate<1|2>	<numeric_value>	HZ	
:MODE	ABSolute | RELative		
:REFerence			
:AUTO	ONCE		no query
:PRESet	ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0		
:BANDwidth	<numeric_value>	PCT	
:BWIDth	<numeric_value>	PCT	

[SENSe:]POWer:ACHannel:SPACing[:UPPer]

This command defines the channel spacing of adjacent channel to carrier.

Syntax: [SENSe:]POWer:ACHannel:SPACing[:UPPer] <numeric_value>
<numeric_value>::= 0 Hz to 1000 MHz

Example: `"POW:ACH:SPAC 28kHz"`

Features: *RST value: 24 kHz
SCPI: conforming

[SENSe:]POWer:ACHannel:ACPairs

This command sets the number of adjacent channels (upper and lower channel in pairs).

Syntax: [SENSe:]POWer:ACHannel:ACPairs 1.| 2 | 3

Example: `"POW:ACH:ACP 3"`

Features: *RST value: 1
SCPI: device-specific

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]

This command sets the channel bandwidth of the radio communication system.

Syntax: [SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel] <numeric_value>
<numeric_value>::= 0 Hz to 1000 MHz

Example: `"POW:ACH:BWID 30kHz"`

Features: *RST value: 24 kHz
SCPI: device-specific

If the channel bandwidth of the adjacent channel is changed the bandwiths of all alternate adjacent channels are automatically set to the same value.

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel

This command defines the channel bandwidth of the adjacent channel of the radio transmission system.

Syntax: [SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel <numeric_value>
<numeric_value>::= 0 Hz to 1000 MHz

Example: `"POW:ACH:BWID:ACH 30kHz"`

Features: *RST value: 24 kHz
SCPI: device-specific

If the channel bandwidth of the adjacent channel is changed the bandwiths of all alternate adjacent channels are automatically set to the same value.

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|2>

This command defines the channel bandwidth of the first/second alternate adjacent channel of the radio transmission system.

Syntax: [SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|2>
<numeric_value>
<numeric_value>::= 0 Hz to 1000 MHz

Example: `"POW:ACH:BWID:ALT2 30kHz"`

Features: *RST value: 24 kHz
SCPI: device-specific

If the channel bandwidth of the alternate adjacent channel no. 1is changed the bandwith of the alternate adjacent channel no. 2 is automatically set to the same value.

[SENSe:]POWer:ACHannel:MODE

This command toggles between absolute and relative measurement.

Syntax: [SENSe:]POWer:ACHannel:MODE ABSolute | RELative

Example: `"POW:ACH:MODE REL"`

Features: *RST value: ABSolute
SCPI: device-specific

For the relative measurement the reference value is set to the currently measured channel power by command `POW:ACH:REF:AUTO ONCE`.

[SENSe:]POWer:ACHannel:REFerence:AUTO

This command sets the reference value to the currently measured channel power.

Syntax: [SENSe:]POWer:ACHannel:REFerence:AUTO ONCE

Example: `"POW:ACH:REF:AUTO ONCE"`

Features: *RST value: -
SCPI: device-specific

This command is an event which is why it is not assigned an *RST value and has no query.

[SENSe:]POWer:ACHannel:PRESet

This command selects the type of power measurement.

Syntax: [SENSe:]POWer:ACHannel:PRESet
ACPower | CPOWer | OBANdwidth|OBWidth | CN | CN0

Example: `"POW:ACH:REF:PRES ACP"`

Features: *RST value: -
SCPI: device-specific

[SENSe:]POWer:BANDwidth|BWIDth

This command defines the percentage of the power with respect to the total power.

Syntax: [SENSe:]POWer:ACHannel:BANDwidth|BWIDth 0 to 100PCT

Example: `"POW:BWID 95PCT"`

Features: *RST value: 99PCT
SCPI: device-specific

This value defines the occupied bandwidth (measurement `POW:ACH:PRES OBW`).

3.6.18.11 SENSe:ROSCillator Subsystem

This subsystem controls the reference oscillator.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:ROSCillator			
:SOURce	INTernal | EXTernal	--	
:EXTernal			
:FREQuency	<numeric_value>	HZ	
[:INTernal]			
:TUNe	<numeric_value>		
:SAVe			no query

[SENSe:]ROSCillator:SOURce

This command controls selection of the reference oscillator.

Syntax: [SENSe:]ROSCillator:SOURce INTernal | EXTernal

Example: `"ROSC:SOUR EXT"`

Features: *RST value: –
SCPI: conforming

If the external reference oscillator is selected, the reference signal must be connected to the rear panel of the instrument. *RST has no influence on this setting.

[SENSe:]ROSCillator:EXTernal:FREQuency

This command defines the frequency of the external reference oscillator.

Syntax: [SENSe:]ROSCillator:EXTernal:FREQuency <numeric_value>
<numeric_value>::= 1MHz to 16MHz

Example: `"ROSC:EXT:FREQ 5MHz"`

Features: *RST value: 10MHz
SCPI: conforming

The value of the external reference frequency (1MHz to 16MHz) is rounded in steps of 1MHz.

[SENSe:]ROSCillator[:INTernal]:TUNe

This command defines the value for the tuning of the internal reference oscillator.

Syntax: [SENSe:]ROSCillator[:INTernal]:TUNe <numeric_value>
<numeric_value>::= 0 to 4095

Example: `"ROSC:TUN 128"`

Features: *RST value: –
SCPI: device-specific

The reference oscillator should be tuned only if an error has been detected in the frequency accuracy check. After PRESET or switching on the FSE, the saved value of the reference frequency is restored.

[SENSe:]ROSCillator[:INTernal]:TUNe:SAVe

This command saves the new value for the tuning of the internal reference oscillator. The factory-set value in the EEPROM is overwritten.

Syntax: [SENSe:]ROSCillator[:INTernal]:TUNe:SAVe

Example: `"ROSC:TUN:SAV"`

Features: *RST value: –
SCPI: device-specific

3.6.18.12 SENSe:SWEep Subsystem

This subsystem controls the sweep parameters.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:SWEep			
:TIME	<numeric_value>	S	
:AUTO	<Boolean>	--	
:COUNt	<numeric_value>	--	
:EGATe	<Boolean>	--	
:LEVel	<numeric_value>	V	
:TYPE	LEVel | EDGE	--	
:POLarity	POSitive|NEGative	--	
:HOLDoff	<numeric_value>	S	
:LENGth	<numeric_value>	S	
:SOURce	EXTernal | RFPower	--	
:GAP	<Boolean>	--	
:PRETrigger	<numeric_value>	S	
:TRGTogap	<numeric_value>	S	
:LENGth	<numeric_value>	S	

[SENSe:]SWEep:TIME

This command defines the duration of the sweep.

Syntax: [SENSe:]SWEep:TIME <numeric_value>
<numeric_value>::= 5 ms to 1000 s

Example: `"SWE:TIME 10s"`

Features: *RST value - (AUTO is set to ON)
SCPI: conforming

If `SWEep:TIME` is directly programmed, automatic coupling is switched off.

[SENSe:]SWEep:TIME:AUTO

This command switches the automatic coupling of the sweep time for the frequency span or bandwidth settings.

Syntax: [SENSe:]SWEep:TIME:AUTO ON | OFF

Example: `"SWE:TIME:AUTO ON"`

Features: *RST value: ON
SCPI: conforming

If `SWEep:TIME` is directly programmed, automatic coupling is switched off.

[SENSe:]SWEep:COUNt

This command defines the number of sweeps started with single sweep.

Syntax: [SENSe:]SWEep:COUNt <numeric_value>
<numeric_value>::= 0 to 32767

Example: `"SWE:COUNT 64"`

Features: *RST value: 0
SCPI: conforming

This parameter defines the number of sweeps or the number of averaging procedures. In the average mode, the value 0 defines a running averaging of measurement data over 10 sweeps.

[SENSe:]SWEep:EGATe

This command controls the sweep with the external gate signal.

Syntax: [SENSe:]SWEep:EGATe ON | OFF

Example: `"SWE:EGAT ON"`

Features: *RST value: OFF
SCPI: device-specific

[SENSe:]SWEep:EGATe:LEVel

This command determines the threshold for the external gate signal.

Syntax: [SENSe:]SWEep:EGATe:LEVel <numeric_value>
<numeric_value>::= -5V to +5V

Example: `"SWE:EGAT:LEV 3V"`

Features: *RST value: 2V
SCPI: device-specific

If `SWEep:TIME` is directly programmed, automatic coupling is switched off.

[SENSe:]SWEep:EGATe:TYPE

This command sets the type of triggering (level or edge) by the external gate signal.

Syntax: [SENSe:]SWEep:EGATe:TYPE LEVel | EDGE

Example: `"SWE:EGAT:TYPE EDGE"`

Features: *RST value: EDGE
SCPI: device-specific

Parameter `EGATe:LENGth` is not used for level triggering.

[SENSe:]SWEep:EGATe:POLarity

This command determines the polarity of the external gate signal.

Syntax: [SENSe:]SWEep:EGATe:POLarity POSitive | NEGative

Example: "SWE:EGAT:POL POS"

Features: *RST value: POSitive
SCPI: device-specific

[SENSe:]SWEep:EGATe:HOLDoff

This command defines the delay time between the external gate signal and the continuation of the sweep.

Syntax: [SENSe:]SWEep:EGATe:HOLDoff <numeric_value>
<numeric_value>::= 0 to 100s

Example: "SWE:EGAT:HOLD 100us"

Features: *RST value: 0s
SCPI: device-specific

The values for the delay time can be set in steps 1, 2, 3 and 5.

[SENSe:]SWEep:EGATe:LENGth

In case of edge triggering, this command determines the time interval in which the analyzer sweeps.

Syntax: [SENSe:]SWEep:EGATe:LENGth <numeric_value>
<numeric_value>::= 0 to 100s

Example: "SWE:EGAT:LENG 10ms"

Features: *RST value: 0s
SCPI: device-specific

The values for the delay time can be set in steps 1, 2, 3 and 5.

[SENSe:]SWEep:EGATe:SOURce

This command toggles between external gate signal and RF power signal.

Syntax: [SENSe:]SWEep:EGATe:SOURce EXTernal | RFPower

Example: "SWE:EGAT:SOUR RFP"

Features: *RST value: EXTernal
SCPI: device-specific

[SENSe:]SWEep:GAP

This command controls the operating mode GAP SWEEP.

Syntax: [SENSe:]SWEep:GAP ON | OFF

Example: `"SWE:GAP ON"`

Features: *RST value: OFF
SCPI: device-specific

Operating mode GAP SWEEP for measurements in the time domain controls the display of measured values. Measured values can be blanked for a defined time range (GAP).

[SENSe:]SWEep:GAP:PRETrigger

This command defines the evaluation time for measured values before the pretrigger time.

Syntax: [SENSe:]SWEep:GAP:PRETrigger <numeric_value>
<numeric_value>::= 0 to 100s (resolution: 50 ns)

Example: `"SWE:GAP:PRET 100us"`

Features: *RST value: 0s
SCPI: device-specific

[SENSe:]SWEep:GAP:TRGTogap

This command defines the time between the pretrigger time and the beginning of the gap (trigger-to-gap time)

Syntax: [SENSe:]SWEep:GAP:TRGTogap <numeric_value>
<numeric_value>::= 0 to 100s (resolution: 50 ns)

Example: `"SWE:GAP:TRGT 50us"`

Features: *RST value: 0s
SCPI: device-specific

[SENSe:]SWEep:GAP:LENGth

This command defines the gap length.

Syntax: [SENSe:]SWEep:GAP:LENGth <numeric_value>
<numeric_value>::= 0 to 100s

Example: `"SWE:GAP:LENG 400us"`

Features: *RST value: 0s
SCPI: device-specific

The gap length can be programmed from 0 to 100s in steps of 1, 2, 3 and 5.

3.6.18.13 SENSe:TV Subsystem

This subsystem controls the optional TV-demodulator (only in conjunction with option TV-Demodulator, FSE-B3).

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe]			
:TV			Option TV-Demodulator
[:STATe]	<Boolean>	--	
:PSOFfset	<numeric_value>	HZ	

[SENSe:]TV[:STATe]

This command switches the optional TV-demodulator on or off.

Syntax: [SENSe:]TV[:STATe] ON | OFF

Example: `"TV ON"`

Features: *RST value: OFF
SCPI: device-specific

This command is available only in conjunction with option TV-Demodulator, FSE-B3.

[SENSe:]TV:PSOFfset

This command defines the frequency offset between video and audio carrier of the measured signal.

Syntax: [SENSe:]TV:PSOFfset <numeric_value>
<numeric_value>::= 0 to 6.5 MHz

Example: `"TV:PSOF 1 MHz"`

Features: *RST value: 5 MHz
SCPI: device-specific

This command is available only in conjunction with option TV-Demodulator, FSE-B3.

3.6.19 SOURce Subsystem

The SOURce subsystem controls the output signals of the analyzer when the option Tracking Generator is installed (FSE-B8 to FSE-B11). In the split screen mode, a distinction is made between SOURce1 (screen A) and SOURce2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
SOURce<1|2>			Option Mitlaufgenerator
:AM			
:STATe	<Boolean>		
:DM			
:STATe	<Boolean>		
:FM			
:STATe	<Boolean>		
:FREQuency			
:OFFSet	<numeric_value>	HZ	
:POWer			
:ALC			
:SOURce	INTernal | EXTernal		
[:LEVel]			
[:IMMediate]			
[:AMPLitude]	<numeric_value>	DBM	
:OFFSet	<numeric_value>	DB	

SOURce<1|2>:AM:STATe

This command switches on or off the external amplitude modulation of the tracking generator.

Syntax: SOURce:AM:STATe ON | OFF

Example: `"SOUR:AM:STAT ON "`

Features: *RST-value: OFF
SCPI: conforming

External ALC and external I/Q-modulation is switched off, if active.

This command is only valid in conjunction with option Tracking Generator, FSE-B8 to B11

SOURce<1|2>:DM:STATe

This command switches on or off the external delta modulation of the tracking generator.

Syntax: SOURce:DM:STATe ON | OFF

Example: `"SOUR:DM:STAT ON "`

Features: *RST- value: OFF
SCPI: conforming

External AM, external ALC, external FM and external frequency offset are switched off, if active.

This command is only valid in conjunction with option Tracking Generator, FSE-B8 to B11

SOURce<1|2>:FM:STATe

This command switches on or off the external frequency modulation of the tracking generator.

Syntax: SOURce:FM:STATe ON | OFF

Example: "SOUR:FM:STAT ON "

Features: *RST-value: OFF
SCPI: conforming

External AM, external I/Q-modulation and frequency offset are switched off, if active. This command is only valid in conjunction with option Tracking Generator, FSE-B8 to B11

SOURce<1|2>:FREQuency:OFFSet

This command defines a frequency offset of the tracking generators to the current analyzer frequency.

Syntax: SOURce:FREQuency:OFFSet <numeric value>
<numeric value>::= -200MHz to 200MHz

Example: "SOUR:FREQ:OFFS "

Features: *RST-value: 0 Hz
SCPI: conforming

External delta modulation is switched off, if active. This command is only valid in conjunction with option Tracking Generator, FSE-B8 to B11

SOURce<1|2>:POWer:ALC:SOURce

This command switches on or off the external level control (ALC).

Syntax: SOURce:POWer:ALC:SOURce INTernal | EXTernal

Example: "SOUR:POW:ALC:SOUR INT "

Features: *RST- value: INT
SCPI: conforming

External AM and external delta modulation are switched off, if active. This command is only valid in conjunction with option Tracking Generator, FSE-B8 to B11

SOURce<1|2>:POWer[:LEVel][:IMMediate][:AMPLitude]

This command defines the level of the tracking generator.

Syntax: SOURce:POWer[:LEVel][:IMMediate][:AMPLitude] <numeric value>
<numeric value>::= -20dBm to 0dBm / Option FSE-B12: -90dBm to 0dBm

Example: "SOUR:POW -20dBm"

Features: *RST- value:
SCPI: conforming

This command is only valid in conjunction with option Tracking Generator, FSE-B8 to B11

SOURce<1|2>:POWer[:LEVel][:IMMediate]:OFFSet

This command defines a level offset for the tracking generator.

Syntax: SOURce:POWer[:LEVel][:IMMediate]:OFFSet <numeric value>
<numeric value>::= -200dB to +200dB

Example: "SOUR:POW:OFFS -10dB"

Features: *RST- value: 0dB
SCPI: conforming

This command is only valid in conjunction with option Tracking Generator, FSE-B8 to B11

3.6.20 STATus Subsystem

The STATus subsystem contains the commands for the status reporting system (see Section 3.8, Status Reporting System"). *RST does not influence the status registers.

COMMAND	PARAMETERS	UNIT	COMMENT
STATus			
:OPERation			
[:EVENt?]	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:PRESet	--	--	
:QUEStionable			
[:EVENt?]	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:POWer			
[:EVENt?]	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:LIMit			
[:EVENt?]	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:LMARgin			
[:EVENt?]	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:SYNC			
[:EVENt?]	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	
:ACPLimit			
[:EVENt?]	--	--	
:CONDition?	--	--	
:ENABle	0 to 65535	--	
:PTRansition	0 to 65535	--	
:NTRansition	0 to 65535	--	

COMMAND	PARAMETERS	UNIT	COMMENT
STATus			
:QUEStionable	--	--	
:FREQuency	--	--	
[:EVENt?]	0 to 65535	--	
:CONDition?	0 to 65535	--	
:ENABle	0 to 65535	--	
:PTRansition	--	--	
:NTRansition	--	--	
:QUEue?			
[:NEXT?]			

STATus:OPERation[:EVENt?]

This command queries the contents of the EVENt section of the STATus:OPERation register.

Syntax: STATus:OPERation[:EVENt?]

Example: `"STAT:OPER?"`

Features: *RST value: –
SCPI: conforming

The contents of the EVENt section is deleted with readout.

STATus:OPERation:CONDition?

This command queries the CONDition section of the STATus:OPERation register.

Syntax: STATus:OPERation:CONDition?

Example: `"STAT:OPER:COND?"`

Features: *RST value: –
SCPI: conforming

Readout does not delete the contents of the CONDition section. The value returned reflects the current hardware status.

STATus:OPERation:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable register.

Syntax: STATus:OPERation:ENABle 0 to 65535

Example: `"STAT:OPER:ENAB 65535"`

Features: *RST value: –
SCPI: conforming

The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

STATus:OPERation:PTRansition

This command sets the edge detectors of all bits of the STATus:OPERation register from 0 to 1 for the transitions of the CONDition bit.

Syntax: STATus:OPERation:PTRansition 0 to 65535

Example: `"STAT:OPER:PTR 65535"`

Features: *RST value: –
SCPI: conforming

STATus:OPERation:NTRansition

This command sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Syntax: STATus:OPERation:NTRansition 0 to 65535

Example: `"STAT:OPER:NTR 65535"`

Features: *RST value: –
SCPI: conforming

STATus:PRESet

This command resets the edge detectors and ENABle parts of all registers to a defined value. All PTRansition parts are set to FFFFh, i.e., all transitions from 0 to 1 are detected. All NTRansition parts are set to 0, i.e., a transition from 1 to 0 in a CONDition bit is not detected. The ENABle part of the STATus:OPERation and STATus:QUEStionable registers are set to 0, i.e., all events in these registers are not passed on.

Syntax: STATus:PRESet

Example: `"STAT:PRES"`

Features: *RST value: –
SCPI: conforming

STATus:QUEStionable[:EVENt?]

This command queries the contents of the EVENt section of the STATus:QUEStionable register.

Syntax: STATus:QUEStionable[:EVENt?]

Example: `"STAT:QUES?"`

Features: *RST value: –
SCPI: conforming

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:CONDition?

This command queries the CONDition section of the STATus:QUEStionable register.

Syntax: STATus:QUEStionable:CONDition?

Example: `"STAT:QUES:COND?"`

Features: *RST value: –
SCPI: conforming

Readout does not delete the contents of the CONDition section.

STATus:QUEStionable:ENABle

This command sets the bits of the ENABle section of the STATus-QUEStionable register.

Syntax: STATus:QUEStionable:ENABle 0 to 65535

Example: `"STAT:QUES:ENAB 65535"`

Features: *RST value: –
SCPI: conforming

The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

STATus:QUEStionable:PTRansition

This command sets the edge detectors of all bits of the STATus:OPERation register from 0 to 1 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:PTRansition 0 to 65535

Example: `"STAT:QUES:PTR 65535"`

Features: *RST value: –
SCPI: conforming

STATus:QUEStionable:NTRansition

This command sets the edge detectors of all bits of the STATus:OPERation register from 1 to 0 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:NTRansition 0 to 65535

Example: `"STAT:QUES:NTR 65535"`

Features: *RST value: –
SCPI: conforming

STATus:QUEStionable:POWer[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:POWer register.

Syntax: STATus:QUEStionable:POWer[:EVENt?]

Example: "STAT:QUES?"

Features: *RST value: –
SCPI: conforming

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:POWer:CONDition?

This command queries the content of the CONDition section of the STATus:QUEStionable:POWer register.

Syntax: STATus:QUEStionable:POWer:CONDition?

Example: "STAT:QUES:COND?"

Features: *RST value: –
SCPI: conforming

Readout does not delete the contents of the CONDition section.

STATus:QUEStionable:POWer:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:POWer register.

Syntax: STATus:QUEStionable:POWer:ENABle 0 to 65535

Example: "STAT:QUES:ENAB 65535"

Features: *RST value: –
SCPI: conforming

The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

STATus:QUEStionable:POWer:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 0 to 1 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:POWer:PTRansition 0 to 65535

Example: "STAT:QUES:PTR 65535"

Features: *RST-value: –
SCPI: conforming

STATus:QUEStionable:POWer:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:POWer register from 1 to 0 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:POWer:NTRansition 0 to 65535

Example: `"STAT:QUES:NTR 65535"`

Features: *RST value: –
SCPI: conforming

STATus:QUEStionable:LIMit[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LIMit register.

Syntax: STATus:QUEStionable:LIMit[:EVENt?]

Example: `"STAT:QUES?"`

Features: *RST value: –
SCPI: device-specific

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:LIMit:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LIMit register.

Syntax: STATus:QUEStionable:LIMit:CONDition?

Example: `"STAT:QUES:COND?"`

Features: *RST value: –
SCPI: device-specific

Readout does not delete the contents of the CONDition section.

STATus:QUEStionable:LIMit:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable register.

Syntax: STATus:QUEStionable:LIMit:ENABle 0 to 65535

Example: `"STAT:QUES:ENAB 65535"`

Features: *RST value: –
SCPI: device-specific

The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

STATus:QUEStionable:LIMit:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 0 to 1 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:LIMit:PTRansition 0 to 65535

Example: `"STAT:QUES:PTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEStionable:LIMit:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:LIMit register from 1 to 0 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:LIMit:NTRansition 0 to 65535

Example: `"STAT:QUES:NTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEStionable:LMARgin[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:LMARgin register.

Syntax: STATus:QUEStionable:LMARgin[:EVENt?]

Example: `"STAT:QUES?"`

Features: *RST value: –
SCPI: device-specific

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:LMARgin:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:LMARgin register.

Syntax: STATus:QUEStionable:LMARgin:CONDition?

Example: `"STAT:QUES:COND?"`

Features: *RST value: –
SCPI: device-specific

Readout does not delete the contents of the CONDition section.

STATus:QUEStionable:LMARgin:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:LMARgin register.

Syntax: STATus:QUEStionable:LMARgin:ENABle 0 to 65535

Example: `"STAT:QUES:ENAB 65535"`

Features: *RST value: –
SCPI: device-specific

The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

STATus:QUEStionable:LMARgin:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: LMARgin register from 0 to 1 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:LMARgin:PTRansition 0 to 65535

Example: `"STAT:QUES:PTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEStionable:LMARgin:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: LMARgin register from 1 to 0 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:LMARgin:NTRansition 0 to 65535

Example: `"STAT:QUES:NTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEStionable:SYNC[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:SYNC register.

Syntax: STATus:QUEStionable:SYNC[:EVENt?]

Example: `"STAT:QUES?"`

Features: *RST value: –
SCPI: device-specific

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:SYNC:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:SYNC register.

Syntax: STATus:QUEStionable:SYNC:CONDition?

Example: `"STAT:QUES:COND?"`

Features: *RST value: –
SCPI: device-specific

Readout does not delete the contents of the CONDition section.

STATus:QUEStionable:SYNC:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable: SYNC register.

Syntax: STATus:QUEStionable:SYNC:ENABle 0 to 65535

Example: `"STAT:QUES:ENAB 65535"`

Features: *RST value: –
SCPI: device-specific

The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

STATus:QUEStionable:SYNC:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: SYNC register from 0 to 1 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:SYNC:PTRansition 0 to 65535

Example: `"STAT:QUES:PTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEStionable:SYNC:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: SYNC register from 1 to 0 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:SYNC:NTRansition 0 to 65535

Example: `"STAT:QUES:NTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEStionable:ACPLimit[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionable:ACPLimit register.

Syntax: STATus:QUEStionable:ACPLimit[:EVENt?]

Example: `"STAT:QUES:ACPL?"`

Features: *RST value: –
SCPI: device-specific

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:ACPLimit:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:ACPLimit register.

Syntax: STATus:QUEStionable:ACPLimit:CONDition?

Example: `"STAT:QUES:ACPL:COND?"`

Features: *RST value: –
SCPI: device-specific

Readout does not delete the contents of the CONDition section.

STATus:QUEStionable:ACPLimit:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:ACPLimit register.

Syntax: STATus:QUEStionable:ACPLimit:ENABle 0 to 65535

Example: `"STAT:QUES:ACPL:ENAB 65535"`

Features: *RST value: –
SCPI: device-specific

The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

STATus:QUEStionable:ACPLimit:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: ACPLimit register from 0 to 1 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:ACPLimit:PTRansition 0 to 65535

Example: `"STAT:QUES:ACPL:PTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEStionable:ACPLimit:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable: ACPLimit register from 1 to 0 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:ACPLimit:NTRansition 0 to 65535

Example: `"STAT:QUES:ACPL:NTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEStionable:FREQuency[:EVENt]?

This command queries the contents of the EVENt section of the STATus:QUEStionableFREQuency register.

Syntax: STATus:QUEStionable:FREQuency[:EVENt?]

Example: `"STAT:QUES:FREQ?"`

Features: *RST value: –
SCPI: device-specific

Readout deletes the contents of the EVENt section.

STATus:QUEStionable:FREQuency:CONDition?

This command queries the contents of the CONDition section of the STATus:QUEStionable:FREQuency register.

Syntax: STATus:QUEStionable:FREQuency:CONDition?

Example: `"STAT:QUES:FREQ:COND?"`

Features: *RST value: –
SCPI: device-specific

Readout does not delete the contents of the CONDition section.

STATus:QUEStionable:FREQuency:ENABle

This command sets the bits of the ENABle section of the STATus:QUEStionable:FREQuency register.

Syntax: STATus:QUEStionable:FREQuency:ENABle 0 to 65535

Example: `"STAT:QUES:FREQ:ENAB 65535"`

Features: *RST value: –
SCPI: device-specific

The ENABle register selectively enables the individual events of the associated EVENt section for the sum bit in the status byte.

STATus:QUEStionable:FREQuency:PTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 0 to 1 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:FREQuency:PTRansition 0 to 65535

Example: `"STAT:QUES:FREQ:PTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEStionable:FREQuency:NTRansition

This command sets the edge detectors of all bits of the STATus:QUEStionable:FREQuency register from 1 to 0 for the transitions of the CONDition bit.

Syntax: STATus:QUEStionable:FREQuency:NTRansition 0 to 65535

Example: `"STAT:QUES:FREQ:NTR 65535"`

Features: *RST value: –
SCPI: device-specific

STATus:QUEue[:NEXT?]

This command queries the earliest entry to the error queue, thus deleting it.

Syntax: STATus:QUEue[:NEXT?]

Example: `"STAT:QUE?"`

Features: *RST value: –
SCPI: conforming

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI (cf. Appendix B). If the error queue is empty, the error number 0, "no error", is returned. This command is identical with the command `SYSTem:ERRor`.

3.6.21 SYSTem Subsystem

This subsystem comprises a series of commands for general functions.

COMMAND	PARAMETERS	UNIT	COMMENT
SYSTem			
:COMMunicate			
:GPIB			
[:SELF]			
:ADDRess	0 to 30	--	
:RTERminator	LFEoi | EOI		
:RDEVice<1|2>			
:ADDRess	0 to 30	--	
:SERial<1|2>			
:CONTrol			
:DTR	IBFull | OFF		
:RTS	IBFull | OFF		
[:RECeive]		--	
:BAUD	<numeric_value>	--	
:BITS	7 | 8		
:PARity			
[:TYPE]	EVEN | ODD | NONE	--	
:SBITs	1 | 2		
:PACE	XON | NONE	--	
:DATE	<num>, <num>, <num>	--	
:DISPlay			
:UPDate	ON | OFF		
:ERRor?	--		query only
:PASSword		--	
[:CENable]	<string>		no query
:PRESet	--		no query
:SET	<block>	--	
:SPEaker		--	
:VOLume	<numeric_value>	--	
:TIME	0 to 23, 0 to 59, 0 to 59		
:VERSion?	--		query only

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess

This command changes the IEC/IEEE-bus address of the unit.

Syntax: SYSTem:COMMunicate:GPIB[:SELF]:ADDRess 0 to 30

Example: `"SYST:COMM:GPIB:ADDR 18"`

Features: *RST value: - (no influence on this parameter)
SCPI: conforming

SYSTem:COMMunicate:GPIB[:SELF]:RTERminator

This command changes the delimiter.

Syntax: SYSTem:COMMunicate:GPIB[:SELF]:RTERminator LFEOI | EOI

Example: `"SYST:COMM:GPIB:RTERM EOI"`

Features: *RST value: LFEOI
SCPI: device-specific

The analyzer contains a DMA-channel for communication via IEC-bus. This ensures maximum speed for the transfer of commands and data. The parser for command decoding integrated in the instrument is, however, only activated by the delimiter when the command is completely transferred. In order to make this possible for the transfer of binary data, too (e. g. trace data which are retransferred into the instrument), the delimiter recognition must be switched to the EOI signal prior to the transfer. Output of binary data from the instrument does not require such a switching.

SYSTem:COMMunicate:GPIB:RDEVice<1|2>:ADDRess

This command changes the IEC/IEEE-bus address of the unit which is selected as hardcopy device 1 or 2, provided that the IEC/IEEE-bus interface of this unit is set as an interface.

Syntax: SYSTem:COMMunicate:GPIB:RDEVice<1|2>:ADDRess 0 to 30

Example: `"SYST:COMM:GPIB:RDEV2:ADDR 5"`

Features: *RST value: 4
SCPI: conforming

SYSTem:COMMunicate:SERial<1|2>:CONTrol:DTR
SYSTem:COMMunicate:SERial<1|2>:CONTrol:RTS

These commands switch the hardware handshake procedure for the given serial interface off (OFF) or on (IBFull).

Syntax: SYSTem:COMMunicate:SERial<1|2>:CONTrol:DTR IBFull | OFF
SYSTem:COMMunicate:SERial<1|2>:CONTrol:RTS IBFull | OFF

Examples: `"SYST:COMM:SER:CONT:DTR OFF"`
`"SYST:COMM:SER2:CONT:RTS IBF"`

Features: *RST value: OFF
SCPI: conforming

The two commands have the same meaning. SERial1 and SERial 2 correspond to device COM1and COM2, respectively.

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BAUD

This command sets the transmission speed for the given serial interface.

Syntax: SYSTem:COMMunicate:SERial<1|2>[:RECeive:]BAUD <numeric_value>
<numeric_value>::= 75 | 150 | 300 | 600 | 1200 | 2400 | 9600

Example: `"SYST:COMM:SER:BAUD 2400"`

Features: *RST value: 9600
SCPI: conforming

SERial1 and SERial 2 correspond to device interface COM1 and COM2, respectively. Permissible values are 75 Baud, 150 Baud, 300 Baud, 600 Baud, 1200 Baud, 2400 Baud, 4800 Baud, 9600 Baud.

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITS

This command defines the number of data bits per data word for the given serial interface.

Syntax: SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITS 7 | 8

Example: `"SYST:COMM:SER2:BITS 7"`

Features: *RST value: 8
SCPI: conforming

SERial1 and SERial 2 correspond to device interface COM1 and COM2, respectively.

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PARity[:TYPE]

This command defines the parity check for the given serial interface.

Syntax: SYSTem:COMMunicate:SERial<1|2>:RECeive:PARity[:TYPE]
EVEN | ODD | NONE

Example: `"SYST:COMM:SER:PAR EVEN"`

Features: *RST value: NONE
SCPI: conforming

SERial1 and SERial 2 correspond to device interface COM1 and COM2, respectively. Permissible values are:

EVEN	even parity
ODD	odd parity
NONE	no parity check.

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:SBITs

This command defines the number of stopbits per data word for the given serial interface.

Syntax: SYSTem:COMMunicate:SERial<1|2>[:RECeive]:SBITs 1|2

Example: `"SYST:COMM:SER:SBITs 2"`

Features: *RST value: 1
SCPI: conforming

SERial1 and SERial 2 correspond to device interface COM1 and COM2, respectively.

SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PACE

This command switches on or off the software handshake for the given serial interface.

Syntax: SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PACE XON | NONE

Example: `"SYST:COMM:SER:PACE XON"`

features: *RST value: NONE
SCPI: conforming

SERial1 and SERial 2 correspond to device interface COM1 and COM2, respectively.

SYSTem:DATE

This command is used to enter the date for the internal calendar.

Syntax: SYSTem:DATE <num>,<num>,<num>
<num>,<num>,<num> ::= 1980 to 2099, 1 to 12, 1 to 31

Example: `" SYST:DATE 1994,12,1"`

Features: *RST value: –
SCPI: conforming

The sequence of entry is year, month, day.

SYSTem:DISPlay:UPDate

This command switches on or off the update of all display elements.

Syntax: SYSTem:DISPlay:UPDate ON | OFF

Example: `" SYST:DISP ON`

Features: *RST value: OFF
SCPI: device specific

SYSTem:ERRor?

This command queries the earliest entry to the error queue, thus deleting it.

Syntax: SYSTem:ERRor?

Example: `"SYST:ERR?"`

Features: *RST value: –
SCPI: conforming

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI (cf. Appendix B). If the error queue is empty, the error number 0, "no error", is returned. This command is identical with the command `STATus:QUEue:NEXT?`. This command is a query which is why it is not assigned an *RST value.

SYSTem:PASSword[:CENable]

This command enables access to the service functions by means of the password.

Syntax: SYSTem:PASSword[:CENable] <string>

Example: `"SYST:PASS 'XXXX'"`

Features: *RST value: –
SCPI: conforming

This command is an event which is why it is not assigned an *RST value and has no query.

SYSTem:SET

This command recalls the instrument setting saved by command SYST:SET?.

Syntax: SYSTem:SET

Example: `"SYST:SET"`

Features: *RST value: –
SCPI: conforming

The receive terminator has to be set to EOI to ensure reliable transfer of data (setting SYST:COMM:GPIB:RTER EOI).

SYSTem:PRESet

This command triggers an instrument reset.

Syntax: SYSTem:PRESet

Example: `"SYST:PRES"`

Features: *RST value: –
SCPI: conforming

The effect of this command corresponds to that of the *PRESET* key with manual control or to the *RST command.

SYSTem:SPEaker:VOLume

This command sets the volume of the built-in loudspeaker for demodulated signals.

Syntax: SYSTem:SPEaker:VOLume <numeric_value>
<numeric_value> ::= 0 to 1

Example: "SYST:SPE:VOL 0.5"

Features: *RST value: 0
SCPI: device-specific

The value 0 is the lowest volume, the value 1 is the highest volume.

SYSTem:TIME

This command sets the internal clock.

Syntax: SYSTem:TIME 0 to 23, 0 to 59, 0 to 59

Example: "SYST:TIME 12,30,30"

Features: *RST value: –
SCPI: conforming

The sequence of entry is hour, minute, second.

SYSTem:VERSion?

This command queries the number of the SCPI version, which is relevant for the instrument.

Syntax: SYSTem:VERSion?

Example: "SYST:VERS?"

Features: *RST value: –
SCPI: conforming

This command is a query which is why it is not assigned an *RST value.

3.6.22 TRACe Subsystem

The TRACe subsystem controls access to the instrument's internal trace memory.

COMMAND	PARAMETERS	UNIT	COMMENT
TRACe			
[:DATA]	TRACE1 | TRACE2 | TRACE3 | TRACE4, <block>|<numeric_value>...	-	
:COPY	TRACE1|TRACE2|TRACE3|TRACE4, TRACE1|TRACE2|TRACE3|TRACE4		

TRACe[:DATA]

This command transfers trace data from the controller to the instrument, the query reads trace data out of the instrument.

Syntax: TRACe[:DATA] TRACE1 | TRACE2 | TRACE3 | TRACE4,
<block>|<numeric_value>
TRACe[:DATA]? TRACE1 | TRACE2 | TRACE3 | TRACE4'

Example:
```
"TRAC TRACE1,"+A$    (A$: data list in the current format)
"TRAC? TRACE1"
```

Features: *RST value: -
SCPI: conforming

The trace data are transferred in the current format (corresponding to the command FORMat ASCii|REAL). The device-internal trace memory is addressed using the trace names 'TRACE1' to 'TRACE4'.
The parameter of the query is the trace name TRACE1 to TRACE4, it indicates which trace memory will be read out.
The transfer of trace data from the controller to the instrument takes place by indicating the trace name and then the data to be transferred. In ASCII format, these data are values separated by commas. If the transfer takes place using the format real (REAL 32), the data are transferred in block format.

Saving and recalling trace data to/from the device-internal hard disk or to/from a floppy is controlled via the commands "`MMEMory:STORe:TRACe`" and "`MMEMory:LOAD:TRACe`" respectively.

TRACe:COPY

This command copies data from one trace to another. The second operand designates the source, the first operand the destination of the data to be copied.

Syntax: TRACe:COPY TRACE1| TRACE2| TRACE3| TRACE4 ,
TRACE1| TRACE2| TRACE3| TRACE4

Example:
```
"TRAC:COPY TRACE1,TRACE2"
```

Features: *RST value:
SCPI: conforming

This command is an event and therefore has no query and no *RST value assigned.

3.6.23 TRIGger Subsystem

The TRIGger subsystem is used to synchronize instrument actions with events. This makes it possible to control and synchronize the start of a sweep. An external trigger signal can be fed to the connector at the rear panel of the instrument. In split screen mode, a distinction is made between TRIGger1 (screen A) and TRIGger2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
TRIGger<1|2>			
[:SEQuence]			
:SOURce	IMMediate | LINE | EXTerna | VIDeo | RFPower | TV | AF	--	TV only with option TV Demodulator
:LEVel			
[:EXTernal]	<numeric_value>	V|MV|UV	
:VIDeo	<numeric_value>	PCT	
:HOLDoff	<numeric_value>	S	
:SLOPe	POSitive|NEGative	--	
:VIDeo	525 | 625		
:FORMat			
:LPFRame			Option TV Demodulator
:FIELd			
:SELect	ALL | ODD | EVEN		Option TV Demodulator
:LINE			
:NUMBer	<numeric_value>		Option TV Demodulator
:SSIGnal			
:POLarity	NEGative | POSitive		Option TV Demodulator
:SYNChronize			
:ADJust			
:FRAMe	<numeric_value>	s	Option FSE-K11or FSE-K10
:AUTO	ONCE		Option FSE-K11or FSE-K10 & FSE-B7
:SLOT	<numeric_value>	s	Option FSE-K11 or FSE-K10
:AUTO	ONCE		Option FSE-K11 or FSE-K10 & FSE-B7
:SOURCe	FRAMe | TSC		Option FSE-K11or FSE-K10 & FSE-B7

TRIGger<1\|2>[:SEQuence]:SOURce

This command selects the trigger source for the start of a sweep.

Syntax: TRIGger<1|2>[:SEQuence]:SOURce IMMediate | LINE | EXTernal | VIDeo | RFPower | TV | AF

Example: `"TRIG:SOUR EXT"`

Features: *RST value: IMMediate
SCPI: conforming

The value IMMediate corresponds to the "FREE RUN" setting.
Selecting the parameter TV is possible only when the option TV-demodulator is fitted, the parameter AF only in the vector signal analysis mode with analog demodulation.

TRIGger<1|2>[:SEQuence]:LEVel[:EXTernal]

This command sets the level of the external trigger source.

Syntax: TRIGger<1|2>[:SEQuence]:LEVel[:EXTernal] <numeric_value>
<numeric_value>::= –5.0 to +5.0V

Example: `"TRIG:LEV 2V"`

Features: *RST value: –5.0V
SCPI: conforming

TRIGger<1|2>[:SEQuence]:LEVel:VIDeo

This command sets the level of the video trigger source.

Syntax: TRIGger<1|2>[:SEQuence]:LEVel:VIDeo <numeric_value>
<numeric_value>::= 0 to 100PCT

Example: `"TRIG:LEV:VID 50PCT"`

Features: *RST value: 50 PCT
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:HOLDoff

This command defines the length of the trigger delay.

Syntax: TRIGger<1|2>[:SEQuence]:HOLDoff <numeric_value>
<numeric_value>::= 0 to 100s

Example: `"TRIG:HOLD 500us"`

Features: *RST value: 0s
SCPI: conforming

TRIGger<1|2>[:SEQuence]:SLOPe

This command selects the slope of the trigger signal.

Syntax: TRIGger<1|2>[:SEQuence]:SLOPe POSitive | NEGative

Example: `"TRIG:SLOP NEG"`

Features: *RST value: POSitive
SCPI: conforming

The selected trigger slope applies to all trigger signal sources.

TRIGger<1|2>[:SEQuence]:VIDeo:FORMat:LPFRame

This command defines the number of lines per frame to be used (525 or 625 lines)

Syntax: TRIGger<1|2>[:SEQuence]:VIDeo:FORMat:LPFRame 525 | 625

Example: `"TRIG:VID:FORM:LPFR 525"`

Features: *RST value:
SCPI: conforming

This command is only valid if option FSE-B3, TV Demodulator, is fitted.

TRIGger<1|2>[:SEQuence]:VIDeo:LINE:NUMBer

This command selects the horizontal synchronizing signal for triggering.

Syntax: TRIGger<1|2>[:SEQuence]:VIDeo:LINE:NUMBer <numeric value>

Example: `"TRIG:VID:LINE:NUMB 17"`

Features: *RST value:
SCPI: conforming

The instrument is triggered at the specified line. This command is only valid if option FSE-B3, TV Demodulator is fitted.

TRIGger<1|2>[:SEQuence]:VIDeo:FIELd:SELect

This command selects the vertical synchronizing signal for triggering.

Syntax: TRIGger<1|2>[:SEQuence]:VIDeo:FIELd:SELect ALL | ODD | EVEN

Example: `"TRIG:VID:FIEL:SEL ALL"`

Features: *RST value:
SCPI: conforming

With the parameter ALL, the instrument is triggered when the field is changed, irrespective of the half fields. With ODD, triggering by the first half field, with even, triggering by the second half field is selected. This command is valid only if option FSE-B3, TV Demodulator, is fitted.

TRIGger<1|2>[:SEQuence]:VIDeo:SSIGnal:POLarity

This command defines the polarity of the video synchronizing signal.

Syntax: TRIGger<1|2>[:SEQuence]:VIDeo:SSIGnal:POLarity NEGative | POSitive

Example: `"TRIG:VID:SSIG:POL NEG "`

Features: *RST value:
SCPI: conforming

This command is valid only if option FSE-B3, TV Demodulator, is fitted.

TRIGger[:SEQuence]:SYNChronize:ADJust:FRAMe

This command defines the correction value for the time offset between the frame trigger and the midamble of the slot selected. The value set is corrected by means of the calculated offsets of the other slots and used as a base value for the correction of all slots.
This correction value is necessary in order to conserve the exact time relation between the trigger event and the midamble of the slot in question in cases where there is no midamble triggering.

Syntax: TRIGger[:SEQuence]:SYNChronize:ADJust:FRAMe <numeric_value>
<numeric_value>::= 0 to 100s

Example: `"TRIG:SYNC:ADJ:FRAM 30us"`

Features: *RST value: -- (depending on the slot selected)
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10.

TRIGger[:SEQuence]:SYNChronize:ADJust:FRAMe:AUTO

This command determines once the correction value for the time offset between the frame trigger and the midamble of the slot selected. The value set is corrected by means of the calculated offsets of the other slots and used as a base value for the correction of all slots.
This correction value is necessary in order to conserve the exact time relation between the trigger event and the midamble of the slot in question in cases where there is no midamble triggering.

Syntax: TRIGger[:SEQuence]:SYNChronize:ADJust:FRAMe:AUTO ONCE

Example: `"TRIG:SYNC:ADJ:FRAMe:AUTO ONCE"`

Features: *RST value: --
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and with option Vector Signal Analysis, FSE-B7.

TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT

This command defines the correction value for the time offset between the frame trigger and the midamble of the slot selected, without influencing the correction values of the other slots.
This correction value is necessary in order to conserve the exact time relation between the trigger event and the midamble of the slot in question in cases where there is no midamble triggering. The value set is corrected by means of the calculated offsets of the other slots and used as a base value for the correction of all slots.

Syntax: TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT <numeric_value>
<numeric_value>::= 0 to 100s

Example: `"TRIG:SYNC:ADJ:SLOT 30us"`

Features: *RST value: -- (depending on slot selected)
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11 or GSM MS Analyzer, FSE-K10.

TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT:AUTO

This command defines the correction value for the time offset between the frame trigger and the midamble of the slot selected. The value set is corrected by means of the calculated offsets of the other slots and used as a base value for the correction of all slots.
This correction value is necessary in order to conserve the exact time relation between the trigger event and the midamble of the slot in question in cases where there is no midamble triggering.

Syntax: TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT:AUTO ONCE

Example: `"TRIG:SYNC:ADJ:SLOT:AUTO ONCE"`

Features: *RST value: --
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10, and with option Vector Signal Analysis, FSE-B7.

TRIGger[:SEQuence]:SYNChronize:SOURce

This command defines the trigger reference point for measurements in the time domain (carrier power, power vs. time). The frame trigger of the base station or mobile may be selected as well as the relation to the midamble (TSC) of the slot to be measured.

Syntax: TRIGger[:SEQuence]:SYNChronize:SOURce FRAME | TSC

Example: `"TRIG:SYNC:SOURce TSC"`

Features: *RST value: FRAME
SCPI: device-specific

This command is available only in conjunction with option GSM BTS Analyzer, FSE-K11, or GSM MS Analyzer, FSE-K10. The parameter TSC requires in addition the option Vector Signal Analysis, FSE-B7.

3.6.24 UNIT Subsystem

The UNIT subsystem is used to switch the basic unit of setting parameters. In split screen mode, a distinction is made between UNIT1 (screen A) and UNIT2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
UNIT<1|2>			
:POWer	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere V | W | DB | PCT | UNITLESS | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ		
:PROBe	<Boolean>		

UNIT<1|2>:POWer

This command selects the default unit for input and output.

Syntax: UNIT<1|2>:POWer DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | V | W | DB | PCT | UNITLESS | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ

Example: `"UNIT:POW DBUV"`

Features: *RST value: DBM
SCPI: conforming

UNIT<1|2>:PROBe

This command determines whether the coding of a probe which is connected to the front panel is taken into consideration (ON) or not (OFF).

Syntax: UNIT<1|2>:PROBe ON | OFF

Example: `"UNIT:PROB OFF"`

Features: *RST value: ON
SCPI: device-specific

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3.7 Instrument Model and Command Processing

The instrument model shown in Fig. 3.7-1 has been made viewed from the standpoint of the servicing of IEC-bus commands. The individual components work independently of each other and simultaneously. They communicate by means of so-called "messages".

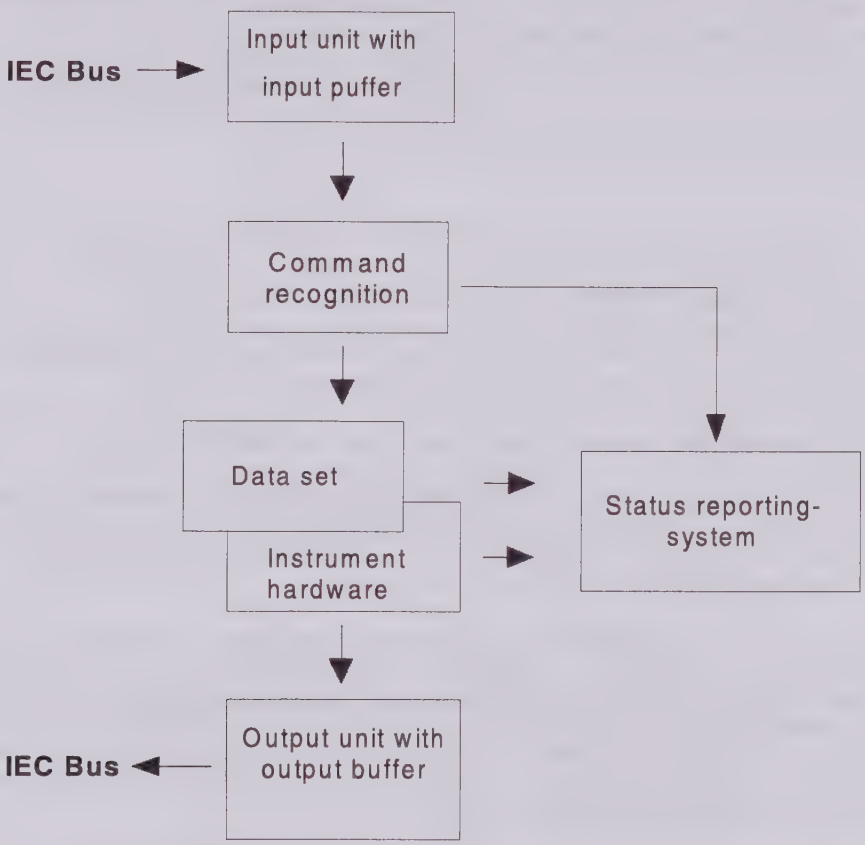

Fig. 3.7-1 Instrument model in the case of remote control by means of the IEC bus

3.7.1 Input Unit

The input unit receives commands character by character from the IEC bus and collects them in the input buffer. The input buffer has a size of 256 characters. The input unit sends a message to the command recognition as soon as the input buffer is full or as soon as it receives a delimiter, <PROGRAM MESSAGE TERMINATOR>, as defined in IEEE 488.2, or the interface message DCL.
If the input buffer is full, the IEC-bus traffic is stopped and the data received up to then are processed. Subsequently the IEC-bus traffic is continued. If, however, the buffer is not yet full when receiving the delimiter, the input unit can already receive the next command during command recognition and execution. The receipt of a DCL clears the input buffer and immediately initiates a message to the command recognition.

3.7.2 Command Recognition

The command recognition analyses the data received from the input unit. It proceeds in the order in which it receives the data. Only a DCL is serviced with priority, a GET (Group Execute Trigger), e.g., is only executed after the commands received before as well. Each recognized command is immediately transferred to the data set but without being executed there at once.
Syntactical errors in the command are recognized here and supplied to the status reporting system. The rest of a command line after a syntax error is analysed further if possible and serviced.
If the command recognition recognizes a delimiter or a DCL, it requests the data set to set the commands in the instrument hardware as well now. Subsequently it is immediately prepared to process commands again. This means for the command servicing that further commands can already be serviced while the hardware is still being set ("overlapping execution").

3.7.3 Data Set and Instrument Hardware

Here the expression "instrument hardware" denotes the part of the instrument fulfilling the actual instrument function - signal generation, measurement etc. The controller is not included.

The data set is a detailed reproduction of the instrument hardware in the software.

IEC-bus setting commands lead to an alteration in the data set. The data set management enters the new values (e.g. frequency) into the data set, however, only passes them on to the hardware when requested by the command recognition. As this is always only effected at the end of a command line, the order of the setting commands in the command line is not relevant.

The data are only checked for their compatibility among each other and with the instrument hardware immediately before they are transmitted to the instrument hardware. If the detection is made that an execution is not possible, an "execution error" is signalled to the status reporting system. All alterations of the data set are cancelled, the instrument hardware is not reset. Due to the delayed checking and hardware setting, however, it is permissible to set impermissible instrument states within one command line for a short period of time without this leading to an error message. At the end of the command line, however, a permissible instrument state must have been reached again.

Before passing on the data to the hardware, the settling bit in the STATus:OPERation register is set (cf. Section 3.8.3.4). The hardware executes the settings and resets the bit again as soon as the new state has settled. This fact can be used to synchronize command servicing.

IEC-bus queries induce the data set management to send the desired data to the output unit.

3.7.4 Status Reporting System

The status reporting system collects information on the instrument state and makes it available to the output unit on request. The exact structure and function are described in Section 3.8

3.7.5 Output Unit

The output unit collects the information requested by the controller, which it receives from the data set management. It processes it according to the SCPI rules and makes it available in the output buffer. The output buffer has a size of 4096 characters. If the information requested is longer, it is made available "in portions" without this being recognized by the controller.
If the instrument is addressed as a talker without the output buffer containing data or awaiting data from the data set management, the output unit sends error message "Query UNTERMINATED" to the status reporting system. No data are sent on the IEC bus, the controller waits until it has reached its time limit. This behaviour is specified by SCPI.

3.7.6 Command Sequence and Command Synchronization

What has been said above makes clear that all commands can potentially be carried out overlapping. Equally, setting commands within one command line are not absolutely serviced in the order in which they have been received.

In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line, that is to say, with a separate IBWRT()-call.
In order to prevent an overlapping execution of commands, one of commands *OPC, *OPC? or *WAI must be used. All three commands cause a certain action only to be carried out after the hardware has been set and has settled. By a suitable programming, the contoller can be forced to wait for the respective action to occur (cf. table 3.7-1).

Table 3.7-1 Synchronisation using *OPC *OPC? and *WAI

Commnd	Action after the hardware has settled	Programming the controller
*OPC	Setting the opteration-complete bit in the ESR	- Setting bit 0 in the ESE - Setting bit 5 in the SRE - Waiting for service request (SRQ)
*OPC?	Writing a "1" into the output buffer	Addressing the instrument as a talker
*WAI	Continuing the IEC-bus handshake	Sending the next command

An example as to command synchronization can be found in annex D "Program Examples".

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3.8 Status Reporting System

The status reporting system (cf. Fig. 3.8-2) stores all information on the present operating state of the instrument, e.g. that the instrument presently carries out an AUTORANGE and on errors which have occurred. This information is stored in the status registers and in the error queue. The status registers and the error queue can be queried via IEC bus.

The information is of a hierarchical structure. The register status byte (STB) defined in IEEE 488.2 and its associated mask register service request enable (SRE) form the uppermost level. The STB receives its information from the standard event status register (ESR) which is also defined in IEEE 488.2 with the associated mask register standard event status enable (ESE) and registers STATus:OPERation and STATus:QUEStionable which are defined by SCPI and contain detailed information on the instrument.

The IST flag ("Individual STatus") and the parallel poll enable register (PPE) allocated to it are also part of the status reporting system. The IST flag, like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills an analog function for the IST flag as the SRE for the service request.

The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in Fig. 3.8-2.

3.8.1 Structure of an SCPI Status Register

Each SCPI register consists of 5 parts which each have a width of 16 bits and have different functions (cf. Fig. 3.8-1). The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. For example, bit 3 of the STATus:OPERation register is assigned to the hardware status "wait for trigger" in all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integer.

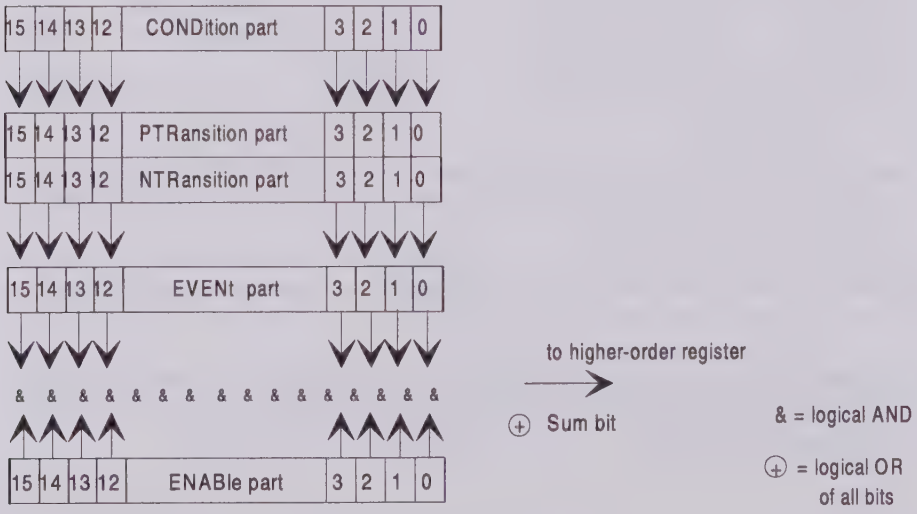

15 14 13 12 CONDition part 3 2 1 0
15 14 13 12 PTRansition part 3 2 1 0
15 14 13 12 NTRansition part 3 2 1 0
15 14 13 12 EVENt part 3 2 1 0
& & & & & & & & & & & & & &
15 14 13 12 ENABle part 3 2 1 0
to higher-order register
⊕ Sum bit
& = logical AND
⊕ = logical OR of all bits

Fig. 3.8-1 The status-register model

CONDition part

The CONDition part is directly written into by the hardware or the sum bit of the next lower register. Its contents reflects the current instrument status. This register part can only be read, but not written into or cleared. Its contents is not affected by reading.

PTRansition part

The Positive-TRansition part acts as an edge detector. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1.
PTR bit =1: the EVENt bit is set.
PTR bit =0: the EVENt bit is not set.
This part can be written into and read at will. Its contents is not affected by reading.

NTRansition part

The Negative-TRansition part also acts as an edge detector. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.
NTR-Bit = 1: the EVENt bit is set.
NTR-Bit = 0: the EVENt bit is not set.
This part can be written into and read at will. Its contents is not affected by reading.

With these two edge register parts the user can define which state transition of the condition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.

EVENt part

The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the edge filters. It is permanently updated by the instrument. This part can only be read by the user. During reading, its contents is set to zero. In linguistic usage this part is often equated with the entire register.

ENABle part

The ENABle part determines whether the associated EVENt bit contributes to the sum bit (cf. below). Each bit of the EVENt part is ANDed with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an OR function (symbol '+').
ENABle-Bit = 0: the associated EVENt bit does not contribute to the sum bit
ENABle-Bit = 1: if the associated EVENT bit is "1", the sum bit is set to "1" as well.
This part can be written into and read by the user at will. Its contents is not affected by reading.

Sum bit

As indicated above, the sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.
The instrument automatically generates the sum bit for each register. Thus an event, e.g. a PLL that has not locked, can lead to a service request throughout all levels of the hierarchy.

Note: *The service request enable register SRE defined in IEEE 488.2 can be taken as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be taken as the ENABle part of the ESR.*

3.8.2 Overview of the Status Registers

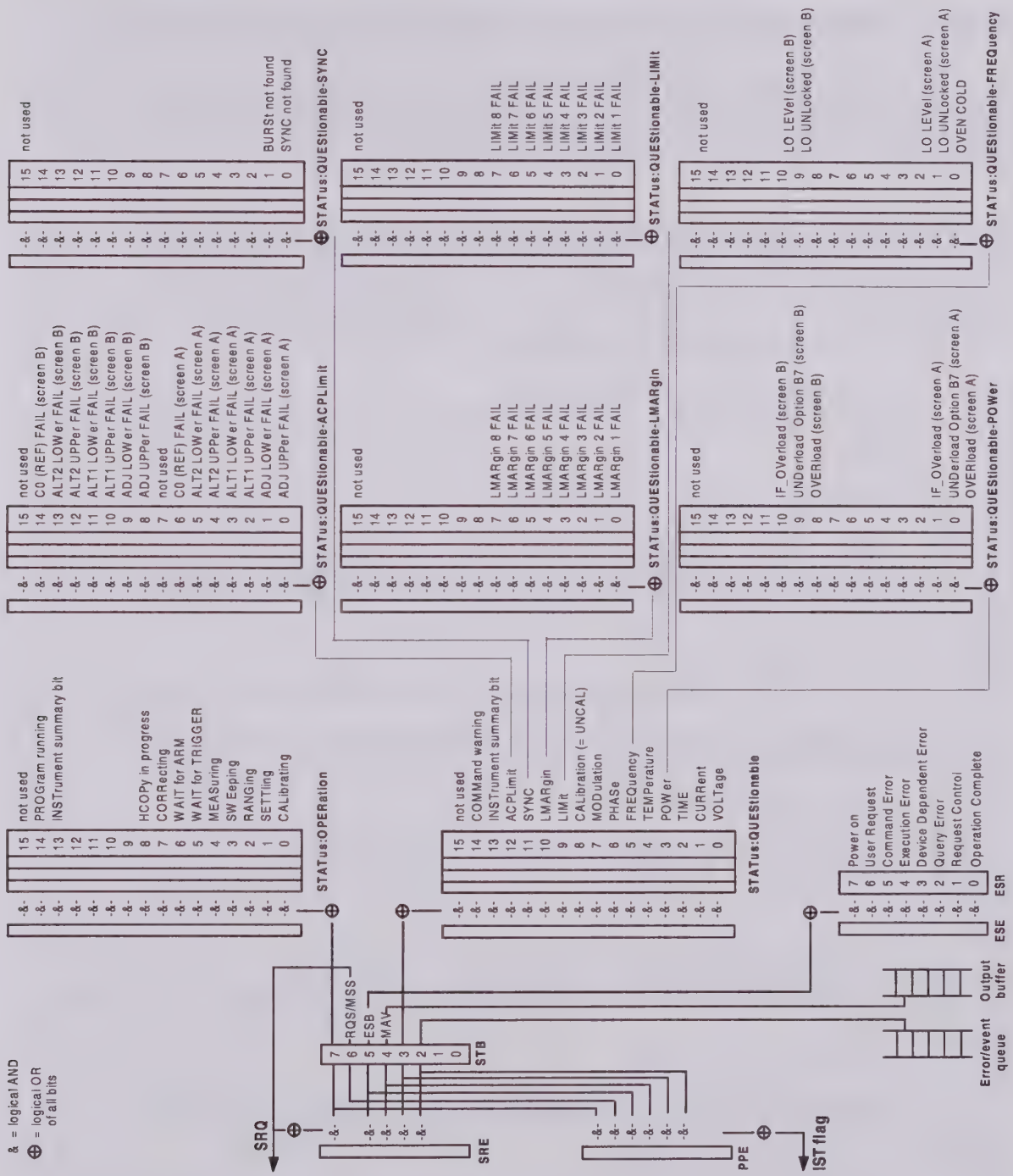


Fig. 3.8-2 Overview of the status registers

3.8.3 Description of the Status Registers

3.8.3.1 Status Byte (STB) and Service Request Enable Register (SRE)

The STB is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. It can thus be compared with the CONDition part of an SCPI register and assumes the highest level within the SCPI hierarchy. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.
The STATUS BYTE is read out using the command "*STB?" or a serial poll.

The STB implies the SRE. It corresponds to the ENABle part of the SCPI registers as to its function. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a Service Request (SRQ) is generated on the IEC bus, which triggers an interrupt in the controller if this is appropriately configured and can be further processed there.
The SRE can be set using command "*SRE" and read using "*SRE?".

Table 3.8-1 Meaning of the bits in the status byte

Bit No.	Meaning
2	**Error Queue not empty** The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a Service Request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with IEC-bus control.
3	**QUEStionable status sum bit** The bit is set if an EVENt bit is set in the QUEStionable-Status register and the associated ENABle bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by polling the QUEStionable-Status register.
4	**MAV bit** (message available) The bit is set if a message is available in the output buffer which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller (cf. annex D, program examples).
5	**ESB bit** Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit implies an error or an event which can be specified in greater detail by polling the event status register.
6	**MSS bit** (master status smmary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	**OPERation status register sum bit** The bit is set if an EVENt bit is set in the OPERation-Status register and the associated ENABle bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by polling the OPERation-status register.

3.8.3.2 IST Flag and Parallel Poll Enable Register (PPE)

By analogy with the SRQ, the IST flag combines the entire status information in a single bit. It can be queried by means of a parallel poll (cf. Section 3.8.4.3) or using command "*IST?".

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are ANDed with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The Ist flag results from the ORing of all results. The PPE can be set using commands "*PRE" and read using command "*PRE?".

3.8.3.3 Event-Status Register (ESR) and Event-Status-Enable Register (ESE)

The ESR is already defined in IEEE 488.2. It can be compared with the EVENt part of an SCPI register. The event status register can be read out using command "*ESR?".
The ESE is the associated ENABle part. It can be set using command "*ESE" and read using command "*ESE?".

Table 3.8-2 Meaning of the bits in the event status register

Bit No.	Meaning
0	**Operation Complete** This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	**Request Control** This bit is set if the instrument requests the controller function. This is the case when hardcopy is outputted to a printer or a plotter via the IEC-bus.
2	**Query Error** This bit is set if either the controller wants to read data from the instrument without having send a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.
3	**Device-dependent Error** This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
4	**Execution Error** This bit is set if a received command is syntactically correct, however, cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue (cf. annex B, Error Messages).
5	**Command Error** This bit is set if a command which is undefined or syntactically incorrect is received. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the rror queue (cf. annex B, -Error Messages).
6	**User Request** This bit is set on pressing the *LOCAL* key, i. e., when the instrument is switched over to manual control.
7	**Power On** (supply voltage on) This bit is set on switching on the instrument.

3.8.3.4 STATus:OPERation Register

In the CONDition part, this register contains information on which actions the instrument is being executing or, in the EVENt part, information on which actions the instrument has executed since the last reading. It can be read using commands `"STATus:OPERation:CONDition?"` or `"STATus:OPERation[:EVENt]?"`.

Table 3.8-3 Meaning of the bits in the STATus.OPERation register

Bit No.	Meaning
0	**CALibrating** This bit is set as long as the instrument is performing a calibration.
1	**SETTling** This bit is set as long as the new status is settling after a setting command. It is only set if the settling time is longer than the command processing time.
2	**RANGing** This bit is set as long as the instrument is changing a range (e.g. Autorange).
3	**SWEeping** This bit is set while the instrument is performing a sweep.
4	**MEASuring** This bit is set while the instrument is performing a measurement.
5	**WAIT for TRIGGER** This bit is set as long as the instrument is waiting for a trigger event.
6	**WAIT for ARM** This bit is set as long as the instrument is waiting for an arming event.
7	**CORRecting** This bit is set while the instrument is performing a correction.
8	**HardCOPy in progress** This bit is set while the instrument is printing a hardcopy.
9 - 12	Device dependent
13	**INSTrument Summary Bit** This bit is set when one or more logical instruments is reporting a status message.
14	**PROGram running** This bit is set while the instrument is performing a program.
15	This bit is always 0

The FSE supports bits 0 and 8.

3.8.3.5 STATus:QUEStionable Register

This register comprises information about indefinite states which may occur if the unit is operated without meeting the specifications. It can be queried by commands `STATus:QUEStionable:CONDition?` and `STATus:QUEStionable[:EVENt]?`.

Table 3.8-4 Meaning of bits in STATus:QUEStionable register

Bit No.	Meaning
0	**VOLTage** This bit is set if a questionable voltage occurs.
1	**CURRent** This bit is set if a questionable current occurs.
2	**TIME** This bit is set if a questionable time occurs.
3	**POWer** This bit is set if a questionable power occurs (cf. also section "STATus:QUEStionable:POWerRegister")
4	**TEMPerature** This bit is set if a questionable temperature occurs.
5	**FREQuency** The bit is set if a frequency is questionable (cf. section "STATus:QUEStionable:FREQuency Register")
6	**PHASe** The bit is set if a phase value is questionable.
7	**MODulation** The bit is set if a modulation is performed questionably.
8	**CALibration** The bit is set if a measurement is performed uncalibrated (≙ label "UNCAL")
9	**LIMit** (unit-dependent) This bit is set if a limit value is violated (see also section STATus:QUEStionable:LIMit Register)
10	**LMARgin** (unit-dependent) This bit is set if a margin is violated (see also section STATus:QUEStionable:LMARgin Register)
11	**SYNC** (unit-dependent) This bit is set if, during measurements with Option B7 (Signal Vector Analysis), the synchronization with midamble or a successful search for bursts cannot be performed (see also STATus:QUEStionable:SYNC Register)
12	**ACPLimit** (unit-dependent) This bit is set if a limit for the adjacent channel power measurement is violated (see also section STATus:QUEStionable:ACPLimit Register)
13	**INSTrument Summary Bit** This bit is set when one or more logical instruments is reporting a message.
14	**COMMand Warning** This bit is set if the instrument ignores parameters when executing a command.
15	This bit is always 0.

The FSE supports bits 3, 5, 8, 9, 10, and 12, bit 11 (SYNC) only with option FSE-B7, Vector Signal Analysis'.

3.8.3.6 STATus QUEStionable:ACPLimit Register

This register comprises information about the observance of limits during adjacent power measurements. It can be queried with commands `STATus:QUEStionable:ACPLimit:CONDition?` and "`STATus:QUEStionable:ACPLimit[:EVENt]?`.

Table 3.8-5 Meaning of bits in STATus:QUEstionable:ACPLimit register

Bit No.	Meaning
0	**ADJ UPPer FAIL(Screen A)** This bit is set if the limit is exceeded in the upper adjacent channel.
1	**ADJ LOWer FAIL (Screen A)** This bit is set if the limit is exceeded in the lower adjacent channel.
2	**ALT1 UPPer FAIL (Screen A)** This bit is set if the limit is exceeded in the upper 1st alternate channel.
3	**ALT1 LOWer FAIL (Screen A)** This bit is set if the limit is exceeded in the lower 1st alternate channel.
4	**ALT2 UPPer FAIL (Screen A)** This bit is set if the limit is exceeded in the upper 2nd alternate channel.
5	**ALT2 LOWer FAIL (Screen A)** This bit is set if the limit is exceeded in the lower 2nd alternate channel.
6	not used
7	**C0 (REF) FAIL (Screen A)** This bit is set if the limit is exceeded in the reference channel.
8	**ADJ UPPer FAIL (Screen B)** This bit is set if the limit is exceeded in the upper adjacent channel.
9	**ADJ LOWer FAIL (Screen B)** This bit is set if the limit is exceeded in the lower adjacent channel.
10	**ALT1 UPPer FAIL (Screen B)** This bit is set if the limit is exceeded in the upper 1st alternate channel.
11	**ALT1 LOWer FAIL (Screen B)** This bit is set if the limit is exceeded in the lower 1st alternate channel.
12	**ALT2 UPPer FAIL (Screen B)** This bit is set if the limit is exceeded in the upper 2nd alternate channel.
13	**ALT2 LOWer FAIL (Screen A)** This bit is set if the limit is exceeded in the lower 2nd alternate channel.
14	not used
15	**C0 (REF) FAIL (Screen B)** This bit is set if the limit is exceeded in the reference channel.

3.8.3.7 STATus QUEStionable:FREQuency Register

This register comprises information about the reference and local oscillator.
It can be queried with commands `STATus:QUEStionable:FREQuency:CONDition?` and "`STATus:QUEStionable:FREQuency[:EVENt]?`.

Table 3.8-6 Meaning of bits in STATus:QUEstionable:FREQuency register

Bit No.	Meaning
0	**OVEN COLD** This bit is set if the reference oscillator has not yet attained its operating temperature. 'OCXO' will then be displayed.
1	**LO UNLocked** (Screen A) This bit is set if the local oscillator no longer locks. 'LO unl' will then be displayed.
2	**LO LEVel** (Screen A) This bit is set if the level of the local oscillator is smaller than the nominal value. 'LO LVL' will then be displayed.
3	not used
4	not used
5	not used
6	not used
7	not used
8	not used
9	**LO UNLocked** (Screen B) This bit is set if the local oscillator no longer locks.' LO unl' will then be displayed.
10	**LO LEVel** (Screen B) This bit is set if the level of the local oscillator is smaller than the nominal value. 'LO LVL' will then be displayed.
11	not used
12	not used
13	not used
14	not used
15	This bit is always 0.

3.8.3.8 STATus QUEStionable:LIMit Register

This register comprises information about the observance of limit lines. It can be queried with commands `STATus:QUEStionable:LIMit:CONDition?` and `STATus:QUEStionable:LIMit[:EVENt]?`.

Table 3.8-7 Meaning of bits in STATus:QUEstionable:LIMit register

Bit No.	Meaning
0	**LIMit 1 FAIL** This bit is set if limit line 1 is violated.
1	**LIMit 2 FAIL** This bit is set if limit line 2 is violated.
2	**LIMit 3 FAIL** This bit is set if limit line 3 is violated.
3	**LIMit 4 FAIL** This bit is set if limit line 4 is violated.
4	**LIMit 5 FAIL** This bit is set if limit line 5 is violated.
5	**LIMit 6 FAIL** This bit is set if limit line 6 is violated.
6	**LIMit 7 FAIL** This bit is set if limit line 7 is violated.
7	**LIMit 8 FAIL** This bit is set if limit line 8 is violated.
8	not used
9	not used
10	not used
11	not used
12	not used
13	not used
14	not used
15	This bit is always 0.

3.8.3.9 STATus QUEStionable:LMARgin Register

This register comprises information about the observance of limit margins. It can be queried with commands `STATus:QUEStionable:LMARgin:CONDition?` and `"STATus:QUEStionable :LMARgin[:EVENt]?.`

Table 3.8-8 Meaning of bits in STATus: QUEstionable:LMARgin register

Bit No.	Meaning
0	**LMARgin 1 FAIL** This bit is set if limit margin 1 is violated.
1	**LMARgin 2 FAIL** This bit is set if limit margin 2 is violated.
2	**LMARgin 3 FAIL** This bit is set if limit margin 3 is violated.
3	**LMARgin 4 FAIL** This bit is set if limit margin 4 is violated.
4	**LMARgin 5 FAIL** This bit is set if limit margin 5 is violated.
5	**LMARgin 6 FAIL** This bit is set if limit margin 1 is violated.
6	**LMARgin 7 FAIL** This bit is set if limit margin 7 is violated.
7	**LMARgin 8 FAIL** This bit is set if limit margin 8 is violated.
8	not used
9	not used
10	not used
11	not used
12	not used
13	not used
14	not used
15	This bit is always 0.

3.8.3.10 STATus QUEStionable:POWer Register

This register comprises all information about possible overloads of the unit.
It can be queried with commands `STATus:QUEStionable :POWer:CONDition?` and "`STATus :QUEStionable:POWer [:EVENt]?`.

Table 3.8-9 Meaning of bits in STATus:QUEstionable:POWer register

Bit No.	Meaning
0	**OVERload** (Screen A) This bit is set if the RF input is overloaded. 'OVLD' will then be displayed.
1	**UNDerload** (Screen A) - option FSE-B7 This bit is set if, during measurements with option FSE-B7 (Signal-Vector Analyzer) without capture buffer used, the lower level limit in the IF path is violated.
2	**IF_OVerload** (Screen A) This bit is set if the IF path is overloaded. 'IFOVLD' will then be displayed.
3	not used
4	not used
5	not used
6	not used
7	not used
8	**OVERload** (Screen B) This bit is set if the RF input is overloaded. 'OVLD' will then be displayed.
9	**UNDerload** (Screen B) - option FSE-B7 This bit is set if, during measurements without capture buffer used, the lower level limit in the IF path is violated.
10	**IF_OVerload** (Screen B) This bit is set if the IF path is overloaded. 'IFOVLD' will then be displayed.
11	not used
12	not used
13	not used
14	not used
15	This bit is always 0.

3.8.3.11 STATus QUEStionable:SYNC Register

This register comprises information about sync and burst events.
It can be queried with commands `STATus:QUEStionable:SYNC:CONDition?` and "`STATus:QUEStionable:SYNC[:EVENt]?`.

Table 3.8-10 Meaning of bits in STATus: QUEstionable:SYNC register

Bit No.	Meaning
0	**SYNC not found** This bit is set if the sync sequence of midamble was not found.
1	**BURSt not found** This bit is set if a burst was not found.
2	not used
3	not used
4	not used
5	not used
6	not used
7	not used
8	not used
9	not used
10	not used
11	not used
12	not used
13	not used
14	not used
15	This bit is always 0.

3.8.4 Application of the Status Reporting Systems

In order to be able to effectively use the status reporting system, the information contained there must be transmitted to the controller and further processed there. There are several methods which are represented in the following. Detailed program examples are to be found in annex D, Program Examples.

3.8.4.1 Service Request, Making Use of the Hierarchy Structure

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react with corresponding actions. As evident from Fig. 3.8-2 (Section 3.8.2), an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The corresponding setting of the ENABle parts of the status registers can achieve that arbitrary bits in an arbitrary status register initiate an SRQ. In order to make use of the possibilities of the service request, all bits should be set to "1" in enable registers SRE and ESE.

Examples (cf. Fig. 3.8-2 and annex D, Program Examples, as well):

Use of command "*OPC" to generate an SRQ at the end of a sweep.

- Set bit 0 in the ESE (Operation Complete)
- Set bit 5 in the SRE (ESB)?

  After its settings have been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should set the instrument such that a service request is initiated in the case of malfunction. The program should react appropriately to the service request. A detailed example for a service request routine is to be found in annex D, Program Examples.

3.8.4.2 Serial Poll

In a serial poll, just as with command "*STB", the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster. The serial-poll method has already been defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works with instruments which do not adhere to SCPI or IEEE 488.2.

The quick-BASIC command for executing a serial poll is "IBRSP()". Serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the IEC bus.

3.8.4.3 Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller by means of a single command to transmit 1 bit of information each on the data lines, i.e., to set the data line allocated to each instrument to logically "0" or "1". By analogy to the SRE register which determines under which conditions an SRQ is generated, there is a parallel poll enable register (PPE) which is ANDed with the STB bit by bit as well considering bit 6. The results are ORed, the result is then sent (possibly inverted) as a response in the parallel poll of the controller. The result can also be queried without parallel poll by means of command "*IST".

The instrument first has to be set for the parallel poll using quick-BASIC command "IBPPC()". This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using "IBRPP()".

The parallel-poll method is mainly used in order to quickly find out after an SRQ which instrument has sent the service request if there are many instruments connected to the IEC bus. To this effect, SRE and PPE must be set to the same value. A detailed example as to the parallel poll is to be found in annex D, Program Examples.

3.8.4.4 Query by Means of Commands

Each part of every status register can be read by means of queries. The individual commands are indicated in the detailed description of the registers in Section 3.8.3. What is returned is always a number which represents the bit pattern of the register queried. Evaluating this number is effected by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

3.8.4.5 Error-Queue Query

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain-text error messages which can be looked at in the ERROR menu via manual control or queried via the IEC bus using command "SYSTem:ERRor?". Each call of "SYSTem:ERRor?" provides an entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

3.8.5 Resetting Values of the Status Reporting System

Table 3.8-11 comprises the different commands and events causing the status reporting system to be reset. None of the commands, except for *RST and SYSTem:PRESet influences the functional instrument settings. In particular, DCL does not change the instrument settings.

Table 3.8-11 Resettting instrument functions

Event / Effect	Switching on supply voltage: Power-On-Status-Clear 0	Switching on supply voltage: Power-On-Status-Clear 1	DCL,SDC (Device Clear, Selected Device Clear)	*RST or SYSTem:PRESet	STATus:PRESet	*CLS
Clear STB,ESR	—	yes	—	—	—	yes
Clear SRE,ESE	—	yes	—	—	—	—
Clear PPE	—	yes	—	—	—	—
Clear EVENTt parts of the registers	—	yes	—	—	—	yes
Clear Enable parts of all OPERation and QUEStionable registers, Fill Enable parts of all other registers with "1".	—	yes	—	—	yes	—
Fill PTRansition parts with "1", Clear NTRansition parts	—	yes	—	—	yes	—
Clear error queue	yes	yes	—	—	—	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	—	—	—

1) Every command being the first in a command line, i.e., immediately following a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.

3.9 Table of Softkeys with IEC/IEEE-Bus Command Assignment

3.9.1 Basic Instrument - Signal Analysis Mode

3.9.1.1 FREQUENCY Key Group

START	
START MANUAL	[SENSe:]FREQuency:STARt <numeric_value>
STOP FIXED	[SENSe:]FREQuency:STARt:LINK STOP
SPAN FIXED	[SENSe:]FREQuency:STARt:LINK SPAN
CENTER FIXED	[SENSe:]FREQuency:STARt:LINK CENTer
STOP	
STOP MANUAL	[SENSe:]FREQuency:STOP <numeric_value>
START FIXED	[SENSe:]FREQuency:STOP:LINK STARt
SPAN FIXED	[SENSe:]FREQuency:STOP:LINK SPAN
CENTER FIXED	[SENSe:]FREQuency:STOP:LINK CENTer
CENTER	
CENTER MANUAL	[SENSe:]FREQuency:CENTer <numeric_value>
SPAN FIXED	[SENSe:]FREQuency:CENTer:LINK SPAN
START FIXED	[SENSe:]FREQuency:CENTer:LINK STARt
STOP FIXED	[SENSe:]FREQuency:CENTer:LINK STOP
FREQUENCY OFFSET	[SENSe:]FREQuency:OFFSet <numeric_value>

STEP	
STEPSIZE MANUAL	[SENSe:]FREQuency:CENTer:STEP <numeric_value>
AUTO 0.1 * RBW	[SENSe:]FREQuency:CENTer:STEP:LINK RBW; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 10PCT
AUTO 0.5 * RBW	[SENSe:]FREQuency:CENTer:STEP:LINK RBW; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 50PCT
AUTO X * RBW	[SENSe:]FREQuency:CENTer:STEP:LINK RBW; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <numeric_value>
AUTO 0.1 * SPAN	[SENSe:]FREQuency:CENTer:STEP:LINK SPAN; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 10PCT
AUTO 0.5 * SPAN	[SENSe:]FREQuency:CENTer:STEP:LINK SPAN; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 50PCT
AUTO X * SPAN	[SENSe:]FREQuency:CENTer:STEP:LINK SPAN; [SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <numeric_value>
STEPSIZE = CENTER	no corresponding IEC/IEEE-bus command
SPAN	
SPAN MANUAL	[SENSe:]FREQuency:SPAN <numeric_value>
ZERO SPAN	[SENSe:]FREQuency:SPAN 0HZ
FULL SPAN	[SENSe:]FREQuency:SPAN:FULL
LAST SPAN	no corresponding IEC/IEEE-bus command
CENTER FIXED	[SENSe:]FREQuency:SPAN:LINK CENTer
START FIXED	[SENSe:]FREQuency:SPAN:LINK START
STOP FIXED	[SENSe:]FREQuency:SPAN:LINK STOP
ZOOM	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM ON|OFF
MOVE ZOOM START	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM[:FREQuency]:STARt <numeric_value>
MOVE ZOOM STOP	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM[:FREQuency]:STOP <numeric_value>
MOVE ZOOM WINDOW	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM[:FREQuency]:CENTer <numeric_value>
ZOOM OFF	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:ZOOM OFF

3.9.1.2 LEVEL Key Group

REF	
MAX LEVEL AUTO	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue:AUTO ON
MAX LEVEL MANUAL	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue:AUTO OFF; DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue <numeric_value>
REF LEVEL	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RLEVel <numeric_value>
REF LEVEL OFFSET	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RLEVel:OFFSet <num_value>
GRID ABS/REL	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:MODE ABSolute|RELative
UNIT	--
dBm	CALCulate<1|2>:UNIT:POWer DBM
dBµV	CALCulate<1|2>:UNIT:POWer DBUV
dBµA	CALCulate<1|2>:UNIT:POWer DBUA
dBpW	CALCulate<1|2>:UNIT:POWer DBPW
VOLT	CALCulate<1|2>:UNIT:POWer VOLT
AMPERE	CALCulate<1|2>:UNIT:POWer AMPere
WATT	CALCulate<1|2>:UNIT:POWer WATT
dBmV	CALCulate<1|2>:UNIT:POWer DBMV
dB*/MHz	CALCulate<1|2>:UNIT:POWer DBUV_MHZ CALCulate<1|2>:UNIT:POWer DBUA_MHZ CALCulate<1|2>:UNIT:POWer DBMV_MHZ
PROBE CODE ON / OFF	UNIT:PROBe ON|OFF

RANGE	
LINEAR/%	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y:SPACing PERCent
LINEAR/dB	DISPlay[:WINDow<1 2>]:TRACe<1...4>:Y:SPACing LINear
LOG MANUAL	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y:SPACing LOGarithmic; DISPlay[:WINDow<1 2>]:TRACe<1...4>:Y[:SCALe] <numeric_value>

3.9.1.3 INPUT Key

INPUT	
RF ATTEN MANUAL	INPut:ATTenuation <numeric_value>
ATTEN AUTO NORMAL	INPut:ATTenuation:AUTO:MODE NORMal; INPut:ATTenuation:AUTO ON
ATTEN AUTO LOW NOISE	INPut:ATTenuation:AUTO:MODE LNOise; INPut:ATTenuation:AUTO ON
ATTEN AUTO LOW DIST	INPut:ATTenuation:AUTO:MODE LDIStortion; INPut:ATTenuation:AUTO ON
MIXER LEVEL	INPut:MIXer <numeric value>
INPUT SELECT	--
RF INPUT 50 OHM	INPut:IMPedance 50
RF INPUT 75 OHM/RAM	INPut:IMPedance:CORRection RAM
RF INPUT 75OHM/RAZ	INPut:IMPedance:CORRection RAZ

3.9.1.4 MARKER Key Group

NORMAL	
MARKER 1..4	CALCulate<1|2>:MARKer<1...4>[:STATe] ON | OFF; CALCulate<1|2>:MARKer<1...4>:X <numeric value>; CALCulate<1|2>:MARKer<1...4>:Y?
ALL MARKER OFF	CALCulate<1|2>:MARKer<1...4>:AOFF

SIGNAL TRACK

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:STRack[:STATe] ON | OFF
```

MARKER INFO

```
DISPlay:WINDow<1|2>:MINFo ON | OFF (display)
queries:
CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:NDBDown:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult? ACPower| CPOWer|
                                                OBANdwidth| OBWidth| CN| CN0
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS:RESult?
CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN:RESult?
```

MARKER ZOOM

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:ZOOM <numeric_value>
```

MARKER DEMOD

```
--
```

AM

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:SELect  AM
```

FM

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation:SELect  FM
```

MKR DEMOD ON/OFF

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:DEModulation[:STATe]  ON | OFF
```

MKR STOP TIME

```
CALCulate<1|2>:MARKer<1..4>:FUNCtion:DEModulation:HOLDoff <num_value>
```

VOLUME

```
SYSTem:SPEaker:VOLume   <numeric_value>
```

SIGNAL COUNT

```
CALCulate<1|2>:MARKer<1...4>:COUNt   ON | OFF;
CALCulate<1|2>:MARKer<1...4>:COUNt:FREQuency?
```

COUNTER RESOL

```
CALCulate<1|2>:MARKer<1...4>:COUNt:RESolution <numeric value>
```

NOISE

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe[:STATe] ON | OFF;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:NOISe:RESult?
```

POWER MEAS SETTINGS

```
--
```

SET NO OF ADJ CHAN'S

```
[SENSe:]POWer:ACHannel:ACPairs
```

ACP STANDARD

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:PRESet
                            NADC | TETRA | PDC | PHS| CDPD | CDMA | NONE
```

CH FILTER ON/OFF

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:CFILter ON | OFF
```

CHANNEL BANDWIDTH

```
[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel] <numeric_value>
[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel <numeric_value>
[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<1|2> <numeric_value>
```

CHANNEL SPACING

```
[SENSe:]POWer:ACHannel:SPACing[:UPPer] <numeric_value>
```

EDIT ACP LIMITS

```
CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel <num_value>,<num_value>
CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:STATe ON | OFF
CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>
                                    <numeric_value>, <numeric_value>
CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>:STATe ON | OFF
```

LIMIT CHECK

```
CALCulate:LIMit:ACPower[:STATe] ON | OFF
CALCulate<1|2>:LIMit<1...8>:ACPower:ACHannel:RESult?
CALCulate<1|2>:LIMit<1...8>:ACPower:ALTernate<1|2>:RESult?
```

% POWER BANDWIDTH

```
[SENSe:]POWer: BANDwidth|BWIDth <numeric_value>
```

CHANNEL POWER

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect CPOWer;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult? CPOWer;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer[:STATe] OFF
```

CP/ACP ABS/REL

```
[SENSe:]POWer:ACHannel:MODE ABSolute|RELative
```

SET CP REFERENCE

```
[SENSe:]POWer:ACHannel:REFerence:AUTO ONCE
```

C/N

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect CN;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult? CN;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer[:STATe] OFF
```

C/No

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect CN0;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult? CN0;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer[:STATe] OFF
```

ADJACENT CHAN POWER

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect ACPower;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult? ACPower;
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer[:STATe] OFF
```

OCCUPIED PWR BANDW

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:SELect OBANdwidth | OBWidth
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer:RESult? OBANdwidth| OBWidth
CALCulate<1|2>:MARKer<1...4>:FUNCtion:POWer[:STATe] OFF
```

ADJUST CP SETTINGS

```
[SENSe:]POWer:ACHannel:PRESet ACPower|CPOWer|OBANdwidth|OBWidth|CN|CN0
```

STEP

STEPSIZE AUTO

```
CALCulate<1|2>:MARKer<1...4>:STEP:AUTO ON | OFF
```

STEPSIZE MANUAL

```
CALCulate<1|2>:MARKer<1...4>:STEP[:INCRement] <numeric_value>
```

MKR TO STEPSIZE

```
CALCulate<1|2>:MARKer<1...4>:FUNCtion:MSTep
```

DELTA

DELTA 1...4

```
CALCulate<1|2>:DELTamarker<1...4>[:STATe]  ON | OFF
CALCulate<1|2>:DELTamarker<1...4>:X <numeric value>
CALCulate<1|2>:DELTamarker<1...4>:X:RELative?
CALCulate<1|2>:DELTamarker<1...4>:Y?
```

ALL DELTA OFF	CALCulate<1|2>:DELTamarker<1...4>:AOFF
DELTA MKR ABS REL	CALCulate<1|2>:DELTamarker<1...4>:MODE ABSolute | RELative
REFERENCE FIXED	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:FIXed[:STATe] ON | OFF
REFERENCE POINT	--
REF POINT FREQUENCY	CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:X <num_value>
REF POINT LEVEL	CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:Y <num_value>
REF POINT LVL OFFSET	CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:Y:OFFSet <num_value>
REF POINT TIME	CALCulate<1|2>:DELTamarker<1..4>:FUNCtion:FIXed:RPOint:X <num_value>
PHASE NOISE	CALCulate<1|2>:DELTamarker<1...4>:FUNCtion:PNOise[:STATe] ON | OFF
STEP	
STEPSIZE AUTO	CALCulate<1|2>:DELTamarker<1...4>:STEP:AUTO ON | OFF
MANUAL STEPSIZE	CALCulate<1|2>:DELTamarker<1...4>:STEP[:INCRement] <numeric_value>
SEARCH	
NEXT PEAK	CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT
NEXT PEAK LEFT	CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT
NEXT PEAK RIGHT	CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt
SELECT MARKER	no corresponding IEC/IEEE-bus command
ACTIVE MKR/DELTA	no corresponding IEC/IEEE-bus command

PEAK	CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK] CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]
MIN	CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK] CALCulate<1 2>:DELTamarker<1...4>:MINimum[:PEAK]
NEXT MIN	CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT
NEXT MIN LEFT	CALCulate<1 2>:MARKer<1...4>:MINimum:LEFT CALCulate<1 2>:DELTamarker<1...4>:MINimum:LEFT
NEXT MIN RIGHT	CALCulate<1 2>:MARKer<1...4>:MINimum:RIGHt CALCulate<1 2>:DELTamarker<1...4>:MINimum:RIGHt
EXLUDE LO ON OFF	CALCulate<1|2>:MARKer<1...4>:LOEXlude ON | OFF
PEAK EXCURSION	CALCulate<1|2>:MARKer<1...4>:PEXCursion <numeric_value>
N dB DOWN	CALCulate<1 2>:MARKer<1...4>:FUNCtion:NDBDown <numeric_value>
SEARCH LIM ON/OFF	CALCulate<1|2>:MARKer<1...4>:X:SLIMits[STATe] ON | OFF
SHAPE FACT 3/60	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor (60dB/3dB) CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor:STATe ON | OFF
SHAPE FACT 6/60	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor (60dB/6dB) CALCulate<1|2>:MARKer<1...4>:FUNCtion:SFACtor:STATe ON | OFF
SUM MKR ON/OFF	CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMMary:MAXimum[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MPEak[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MIDDle[:STATe] ON | OFF
SUMMARY MARKER	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MAXimum:RESult? CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak:RESult? CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MPEak:RESult? CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MIDDle:RESult? CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS:RESult? CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN:RESult?
AVERAGE ON/OFF	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:AVERage ON | OFF
MEAN	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN[:STATe] ON | OFF
PEAK HOLD ON/OFF	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PHOLd ON | OFF
RMS	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS[:STATe] ON | OFF
ALL SUM MKR OFF	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:AOFF

CALCulate<1|2>:MARKer<1...4>:FUNCtion:CENTer

CALCulate<1|2>:MARKer<1...4>:FUNCtion:CSTep

CALCulate<1|2>:MARKer<1...4>:FUNCtion:REFerence

CALCulate<1|2>:MARKer<1...4>:FUNCtion:STARt

CALCulate<1|2>:MARKer<1...4>:FUNCtion:STOP

CALCulate<1|2>:MARKer<1...4>:TRACe <numeric value>
CALCulate<1 2>:DELTamarker<1...4>:TRACe <numeric value>

3.9.1.5 LINES Key Group

D LINES

DISPLAY LINE 1/2
```
CALCulate:DLINe<1|2>:STATe  ON | OFF;
CALCulate:DLINe<1|2> <numeric_value>
```

FREQUENCY LINE 1/2
```
CALCulate:FLINe<1|2>:STATe ON | OFF;
CALCulate:FLINe<1|2> <numeric_value>
```

REFERENCE LINE
```
CALCulate:RLINe:STATe ON | OFF;
CALCulate:RLINe <numeric_value>
```

THRESHOLD LINE
```
CALCulate:THReshold ON | OFF;
CALCulate:THReshold <numeric_value>
```

TIME LINE 1/2
```
CALCulate:TLINe<1|2>:STATe ON | OFF;
CALCulate:TLINe<1|2> <numeric_value>
```

LIMITS

SELECT LIMIT LINE
```
CALCulate<1|2>:LIMit<1...8>:NAME <string>;
CALCulate<1|2>:LIMit<1...8>:STATe ON | OFF
```

COPY LIMIT LINE
```
CALCulate<1|2>:LIMit<1...8>:COPY 1...8 | <name>
```

DELETE LIMIT LINE
```
CALCulate<1|2>:LIMit<1...8>:DELete
```

X OFFSET
```
CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFset <numeric_value>
```

Y OFFSET
```
CALCulate<1|2>:LIMit<1...8>:UPPer:OFFset <numeric_value>
CALCulate<1|2>:LIMit<1...8>:LOWer:OFFset <numeric_value>
```

EDIT LIMIT LINE
```
CALCulate<1|2>:LIMit<1...8>:UNIT DBM| DBPW| WATT| DBUV| VOLT|DBUA|
       AMPere| DB| DBUV_MHZ| DBUA_MHZ| DEG| RAD| S| HZ| PCT | UNITLESS
CALCulate<1|2>:LIMit<1...8>:CONTrol[:DATA] <num_value>, <num_value>..
CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain   FREQuency|TIME
CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFset <numeric_value>
CALCulate<1|2>:LIMit<1...8>:CONTrol:MODE   RELative | ABSolute
CALCulate<1|2>:LIMit<1...8>:CONTrol:UNIT[:TIME] S | SYM
CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA] <num_value>, <num_value>..
CALCulate<1|2>:LIMit<1...8>:UPPer:STATe   ON | OFF
CALCulate<1|2>:LIMit<1...8>:UPPer:OFFset <numeric_value>
CALCulate<1|2>:LIMit<1...8>:UPPer:MARGin <numeric_value>
CALCulate<1|2>:LIMit<1...8>:UPPer:MODE   RELative | ABSolute
CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA] <num_value>,<num_value>..
CALCulate<1|2>:LIMit<1...8>:LOWer:STATe ON | OFF
CALCulate<1|2>:LIMit<1...8>:LOWer:OFFset <numeric_value>
CALCulate<1|2>:LIMit<1...8>:LOWer:MARGin <numeric_value>
CALCulate<1|2>:LIMit<1...8>:LOWer:MODE   RELative | ABSolute
```

NEW LIMIT LINE	see EDIT LIMIT LINE
NAME	CALCulate<1|2>:LIMit<1...8>:NAME <string>
DELETE VALUE	no corresponding IEC/IEEE-bus command
INSERT VALUE	no corresponding IEC/IEEE-bus command
VALUES	no corresponding IEC/IEEE-bus command
SAVE LIMIT LINE	automatically executed during IEC/IEEE-bus operation
SHIFT X LIMIT LINE	CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt <numeric_value>
SHIFT Y LIMIT LINE	CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt <numeric_value> CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt <numeric_value>

3.9.1.6 TRACE Key Group

TRACE 1

CLEAR/WRITE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE WRITe
VIEW	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE VIEW
AVERAGE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE AVERage
BLANK	DISPlay[:WINDow<1|2>]:TRACe<1...4>[:STATe] OFF
MAX HOLD	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE MAXHold
MIN HOLD	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE MINHold
HOLD CONT ON/OFF	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:HCONtinuous ON|OFF
SWEEP COUNT	[SENSe:]SWEep:COUNt <numeric_value>
ANALOG TR ON/OFF	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:ANALog ON|OFF
COPY..	TRACe:COPY TRACE1| TRACE2| TRACE3| TRACE4 , TRACE1| TRACE2| TRACE3| TRACE4

DETECTOR	--
AUTO SELECT	[SENSe:]DETector[:FUNCtion]:AUTO ON | OFF
DETECTOR AUTOPEAK	[SENSe:]DETector[:FUNCtion] APEak
DETECTOR MAX PEAK	[SENSe:]DETector[:FUNCtion] POSitive
DETECTOR MIN PEAK	[SENSe:]DETector[:FUNCtion] NEGative
DETECTOR SAMPLE	[SENSe:]DETector[:FUNCtion] SAMPle
DETECTOR RMS	[SENSe:]DETector[:FUNCtion] RMS
DETECTOR AVERAGE	[SENSe:]DETector[:FUNCtion] AVERage
TRACE MATH	--
T1-REF ->T1	CALCulate<1|2>:MATH<1...4>[:EXPRession][:DEFine] <expr>
T1-T2/T3/T4 +REF->T1	CALCulate<1|2>:MATH<1...4>[:EXPRession][:DEFine] <expr>
TRACE MATH OFF	CALCulate<1|2>:MATH<1...4>:STATe ON | OFF
ADJUST TO TRACE	no corresponding IEC/IEEE-bus command

3.9.1.7 SWEEP Key Group

COUPLING	
RES BW AUTO	[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO ON | OFF
RES BW MANUAL	[SENSe:]BANDwidth|BWIDth[:RESolution] <numeric_value>
VIDEO BW AUTO	[SENSe:]BANDwidth|BWIDth:VIDeo:AUTO ON | OFF
VIDEO BW MANUAL	[SENSe:]BANDwidth|BWIDth:VIDeo <numeric_value>
COUPLING DEFAULT	[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO ON; [SENSe:]BANDwidth|BWIDth:VIDeo:AUTO ON; [SENSe:]SWEep:TIME:AUTO ON
RBW 1kHz ANA/DIG	[SENSe:]BANDwidth|BWIDth[:RESolution]:MODE ANALog | DIGital
RBW <=1kHz FFT/NORM	[SENSe:]BANDwidth|BWIDth[:RESolution]:MODE:FFT ON | OFF
SWEEP TIME AUTO	[SENSe:]SWEep:TIME:AUTO ON | OFF
SWEEP TIME MANUAL	[SENSe:]SWEep:TIME <numeric_value>
MAIN PLL BANDWIDTH	[SENSe:]BANDwidth|BWIDth:PLL AUTO | HIGH | MEDium | LOW
COUPLING RATIO	--
RBW / VBW SINE [1]	[SENSe:]BANDwidth|BWIDth:VIDeo SINe
RBW / VBW MANUAL	[SENSe:]BANDwidth|BWIDth:VIDeo <numeric_value>
RBW / VBW NOISE [10]	[SENSe:]BANDwidth|BWIDth:VIDeo NOISe
RBW / VBW PULSE [.1]	[SENSe:]BANDwidth|BWIDth:VIDeo PULSe
SPAN / RBW AUTO [50]	[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio 0.02
SPAN / RBW MANUAL	[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio <numeric_value>

TRIGGER	
FREE RUN	TRIGger[:SEQuence]:SOURce IMMediate
LINE	TRIGger[:SEQuence]:SOURce LINE
VIDEO	TRIGger[:SEQuence]:SOURce VIDeo TRIGger[:SEQuence]:LEVel:VIDeo <numeric value>
EXTERN	TRIGger[:SEQuence]:SOURce EXTernal TRIGger[:SEQuence]:LEVel[:EXTernal] <numeric_value>
RF POWER	TRIGger[:SEQuence]:SOURce RFPower
SLOPE POS/NEG	TRIGger[:SEQuence]:SLOPe POSitive|NEGative
TRIGGER DELAY	TRIGger[:SEQuence]:HOLDoff <numeric_value>
SWEEP	
CONTINUOUS SWEEP	INITiate:CONTinuous ON
SINGLE SWEEP	INITiate:CONTinuous OFF
SWEEP COUNT	[SENSe:]SWEep:COUNt <numeric_value>
SGL SWEEP DISP OFF	INITiate:DISPlay ON | OFF
GATE ON/OFF	[SENSe:]SWEep:EGATe ON | OFF
GATE SETTINGS	
GATE LEVEL	[SENSe:]SWEep:EGATe:LEVel <numeric_value>
GATE MODE LEVEL/EDGE	[SENSe:]SWEep:EGATe:TYPE LEVel | EDGE
GATE POL POS/NEG	[SENSe:]SWEep:EGATe:POLarity POSitive | NEGative

GATE DELAY	[SENSe:]SWEep:EGATe:HOLDoff <numeric_value>
GATE LENGTH	[SENSe:]SWEep:EGATe:LENGth <numeric_value>
GATE EXTERN	[SENSe:]SWEep:EGATe:SOURce EXTernal
GATE RF POWER	[SENSe:]SWEep:EGATe:SOURce RFPower
GAP SWEEP ON/OFF	[SENSe:]SWEep:GAP ON | OFF
GAP SWEEP SETTINGS	--
TRIGGER LEVEL	TRIGger[:SEQuence]:LEVel:VIDeo <numeric value>
PRE TRIGGER	[SENSe:]SWEep:GAP:PRETrigger <numeric_value>
GAP LENGTH	[SENSe:]SWEep:GAP:LENGth <numeric_value>
TRG TO GAP TIME	[SENSe:]SWEep:GAP:TRGTogap <numeric_value>

3.9.2 Basic Instrument - General Device Settings

3.9.2.1 DATA VARIATION Key Group

HOLD	
LOCK ALL	no corresponding IEC/IEEE-bus command
LOCK DATA	no corresponding IEC/IEEE-bus command
UNLOCK	no corresponding IEC/IEEE-bus command
STEP	if needed, the step width is entered in the subsystem of the corresponding parameter.
STEPSIZE AUTO	--
STEPSIZE MANUAL	--

3.9.2.2 SYSTEM Key Group

DISPLAY	
ACTIVE SCREEN A	The screen is selected via the numeric suffix of the individual commands.
FULL SCREEN	`DISPlay:FORmat SINGle`
SPLIT SCREEN	`DISPlay:FORmat SPLit`
SCREEN COUPLING	`--`
COUPLING CONTROL	`INSTrument:COUPle CONTrol`
HORIZONTAL SCALING	`INSTrument:COUPle X`
MODE COUPLED	`INSTrument:COUPle MODE`
SCREENS UNCOUPLED	`INSTrument:COUPle NONE | ALL`
VERTICAL SCALING	`INSTrument:COUPle Y`

CONFIG DISPLAY	--
SELECT OBJECT	--
BRIGHTNESS	DISPlay:CMAP:HSL <hue>,<sat>,<lum>
DATA ENTRY	--
DATAENTRY X	no corresponding IEC/IEEE-bus command
DATAENTRY Y	no corresponding IEC/IEEE-bus command
DEFAULT POSITION	no corresponding IEC/IEEE-bus command
DATAENTRY OPAQUE	no corresponding IEC/IEEE-bus command
PREDEFINED COLORS	DISPlay:CMAP<1...13>:PDEFined BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta
DEFAULT COLORS	DISPlay:CMAP<1...13>:DEFault
FREQUENCY ON/OFF	DISPlay:ANNotation:FREQuency ON|OFF
LOGO ON/OFF	DISPlay:LOGO ON|OFF
SATURATION	DISPlay:CMAP<1...13>:HSL <hue>,<sat>,<lum>
TINT	DISPlay:CMAP<1...13>:HSL <hue>,<sat>,<lum>
TIME ON OFF	DISPlay[:WINDow<1|2>]:TIME ON | OFF
DISPLAY COMMENT	DISPlay[:WINDow<1|2>]:TEXT[:DATA] <string> DISPlay[:WINDow<1|2>]:TEXT:STATe ON | OFF
CAL	
CAL CORR ON/OFF	CALibration:STATe ON | OFF
CAL LO SUPP	CALibration:LOSuppression?
CAL LOG	CALibration:LDETector?

CAL RES BW	CALibration:BANDwidth|BWIDth[:RESolution]?
CAL SHORT	CALibration:SHORt?
CAL TOTAL	CALibration[:ALL]?
CAL RESULTS	no corresponding IEC/IEEE-bus command
CAL I/Q	CALibration:IQ?
PRESEL PEAK	CALibration:PPEak?
INFO	
FIRMWARE VERSION	*IDN?
HARDWARE+ OPTIONS	*OPT?
SELFTEST	*TST?
EXECUTE TESTS	*TST?
SYSTEM MESSAGES	SYSTem:ERRor?
CLEAR ALL MESSAGES	--
CLEAR MESSAGE	SYSTem:ERRor?
UPDATE MESSAGES	--

3.9.2.3 CONFIGURATION Key Group

MODE — The submenus are described under the associated operating mode.

ANALYZER — `INSTrument[:SELect] SANalyzer`

VECTOR ANALYZER — `INSTrument[:SELect] SANalyzer | DDEMod`

TRACKING GENERATOR — `OUTPut:[:STATe] ON | OFF`

TV DEMOD — `[SENSe:]TV[:STATe] ON | OFF`

SETUP

TRANSDUCER — `--`

- TRANSDUCER FACTOR — `[SENSe:]CORRection:TRANsducer:SELect <name>`
`[SENSe:]CORRection:TRANsducer[:STATe] ON | OFF`
- TRANSDUCER SET — `[SENSe:]CORRection:TSET:SELect <name>`
`[SENSe:]CORRection:TSET[:STATe] ON | OFF`
- EDIT TRD FACTOR — `[SENSe:]CORRection:TRANsducer:SCALing LINear|LOGarithmic`
  - TRD FACTOR NAME — `[SENSe:]CORRection:TRANsducer:SELect <name>`
  - TRD FACTOR UNIT — `[SENSe:]CORRection:TRANsducer:UNIT <string>`
  - TRD FACTOR VALUES — `[SENSe:]CORRection:TRANsducer:DATA <freq>,<level>..`
  - INSERT LINE — no corresponding IEC/IEEE-bus command
  - DELETE LINE — no corresponding IEC/IEEE-bus command
  - SAVE TRD FACTOR — automatically executed during IEC/IEEE-bus operation
- EDIT TRD SET — `--`
  - TRANSD SET NAME — `[SENSe:]CORRection:TSET:SELect <name>`
  - TRANSD SET UNIT — `[SENSe:]CORRection:TSET:UNIT <string>`

TRANSD SET RANGES	[SENSe:]CORRection:TSET:RANGe<1...10> <freq>,<freql>,<name>..
INSERT LINE	no corresponding IEC/IEEE-bus command
DELETE LINE	no corresponding IEC/IEEE-bus command
SAVE TRD SET	automatically executed during IEC/IEEE-bus operation
NEW FACT/SET	see *EDIT TRD FACTOR* or *EDIT TRD SET*
DELETE FACTOR/SET	[SENSe:]CORRection:TRANsducer:DELete [SENSe:]CORRection:TSET:DELete
OPTIONS	no corresponding IEC/IEEE-bus command
EXTERNAL REFERENCE	[SENSe:]ROSCillator:EXTernal:FREQuency <numeric_value>
REFERENCE INT/EXT	[SENSe:]ROSCillator:SOURce INTernal|EXTernal
GENERAL SETUP	
GPIB ADDRESS	SYSTem:COMMunicate:GPIB[:SELF]:ADDRess 0...30
KEY CLICK ON/OFF	no corresponding IEC/IEEE-bus command
USER PORT A/B	INPut:UPORt<1|2>[:VALue]? INPut:UPORt<1|2>:STATe ON | OFF OUTPut:[:STATe] ON | OFF OUTPut:UPORt<1|2>[:VALue] <Binary>
COM PORT 1/2	SYSTem:COMMunicate:SERial<1|2>:CONTrol:DTR IBFull | OFF SYSTem:COMMunicate:SERial<1|2>:CONTrol:RTS IBFull | OFF SYSTem:COMMunicate:SERial<1|2>[:RECeive:]BAUD <numeric_value> SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITS 7 | 8 SYSTem:COMMunicate:SERial<1|2>:RECeive:PARity[:TYPE] EVEN | ODD | NONE SYSTem:COMMunicate:SERial<1|2>[:RECeive]:SBITs 1|2 SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PACE XON | NONE
DATE	SYSTem:DATE <num>,<num>,<num>
EXTERNAL KEYBOARD	no corresponding IEC/IEEE-bus command
TIME	SYSTem:TIME 0...23, 0...59, 0...59
MOUSE	no corresponding IEC/IEEE-bus command

SERVICE	--
ENTER PASSWORD	SYSTem:PASSword[:CENable] <string>
INPUT CAL	DIAGnostic:SERVice:INPut[:SELect] CALibration
INPUT RF	DIAGnostic:SERVice:INPut[:SELect] RF
NOISE SOURCE	DIAGnostic:SERVice:NSOurce ON | OFF
REFERENCE ADJUST	--
REFERENCE	[SENSe:]ROSCillator:[INTernal:]TUNe <numeric_value>
REFERENCE PROC	[SENSe:]ROSCillator:[INTernal:]TUNe:SAVe
SERVICE FUNCTION	DIAGnostic:SERVice:FUNCtion <numeric_value>,<numeric_value>...
HARMONIC GENERATOR	DIAGnostic:SERVice:HGENerator OFF | 10KHZ | 100KHZ | BALanced

3.9.2.4 STATUS Key Group

LOCAL	Device message "Go to LOCAL (GTL)"

3.9.2.5 HARDCOPY Key Group

START	HCOPy[:IMMediate<1|2>]
SETTINGS	
COPY SCREEN	HCOPy:ITEM:ALL
COPY TABLE	HCOPy:ITEM:WINDow<1|2>:TABle:STATe ON | OFF
COPY TRACE	HCOPy:ITEM:WINDow<1|2>:TRACe:STATe ON | OFF
TRC COLOR AUTO INC	HCOPy:ITEM:WINDow<1|2>:TRACe:CAINcrement ON | OFF
SELECT QUADRANT	--
FULL PAGE	HCOPy:PAGE:DIMensions:FULL
LOWER LEFT	HCOPy:PAGE:DIMensions:QUADrant 2
LOWER RIGHT	HCOPy:PAGE:DIMensions:QUADrant 4
UPPER LEFT	HCOPy:PAGE:DIMensions:QUADrant 1
UPPER RIGHT	HCOPy:PAGE:DIMensions:QUADrant 3
ENTER TEXT	--
COMMENT SCREEN A/B	HCOPy:ITEM:WINDow<1|2>:TEXT <string>
TITLE	HCOPy:ITEM:LABel:TEXT <string>
HARDCOPY DEVICE	HCOPy:DEVice:LANGuage HPGL | PCL4 | PCL5 | POSTscript | ESCP | WMF|PCX | HP7470 | EPSON24| EPSON24C | PCL4_C | PCL4_C3 | PCL4_H | PCL4_CH | PCL4_C3H | LASERJ | DESKJ | DESKJ_C | DESKJ_C3 | DESKJ_H | DESKJ_CH | DESKJC3H | HPGL_LS | HP7470LS
SETTINGS DEVICE 1/2	HCOPy:DESTination<1|2> <string> MMEMory:NAME <file_name> HCOPy:DEVice:PRESet<1|2> ON|OFF HCOPy:DEVice:RESolution<1|2> 150|300 HCOPy:ITEM:FFEed<1|2>:STATe ON|OFF HCOPy:PAGE:ORIentation<1|2> LANDscape | PORTrait
ENABLE DEV1/DEV2	The output device to be used is specified as a numeric suffix <1|2> after the command HCOPy:IMMediate
COLOR ON/OFF	HCOPy:DEVice:COLor ON | OFF

3.9.2.6 MEMORY Key Group

CONFIG

EDIT PATH	MMEMory:MSIS <device> MMEMory:CDIRectory <directory_name>
DELETE	MMEMory:DELete <file_name> MMEMory:RDIRectory <directory_name>
FORMAT DISK	MMEMory:INITialize <msus>
MAKE DIRECTORY	MMEMory:MDIRectory <directory_name>
RENAME	MMEMory:MOVE <file_source>,<file_destination>
SORT MODE	no corresponding IEC/IEEE-bus command
COPY	MMEMory:COPY <file_source>,<file_destination>

SAVE

DATA SET LIST	--
EDIT COMMENT	MMEMory:COMMent <string>
EDIT NAME	MMEMory:STORe:STATe 1,<file_name>
EDIT PATH	The path is included in the file names.
DATA SET CLEAR	MMEMory:CLEar:STATe 1,<file_name>
DATA SET CLEAR ALL	MMEMory:CLEar:ALL
SELECT ITEMS TO SAVE	--

DEFAULT CONFIG

```
MMEMory:SELect[:ITEM]:DEFault
```

DISABLE ALL ITEMS

```
MMEMory:SELect[:ITEM]:NONE
```

ENABLE ALL ITEMS

```
MMEMory:SELect[:ITEM]:ALL
```

SELECT ITEMS

```
MMEMory:SELect[:ITEM]:GSETup ON|OFF
MMEMory:SELect[:ITEM]:HWSettings ON|OFF
MMEMory:SELect[:ITEM]:TRACe<1...4> ON|OFF
MMEMory:SELect[:ITEM]:LINes[:ACTive] ON|OFF
MMEMory:SELect[:ITEM]:LINes:ALL ON|OFF
MMEMory:SELect[:ITEM]:CSETup ON|OFF
MMEMory:SELect[:ITEM]:HCOPy ON|OFF
MMEMory:SELect[:ITEM]:MACRos ON|OFF
MMEMory:SELect[:ITEM]:SCData ON|OFF
MMEMory:SELect[:ITEM]:TRANsducer[:ACTive] ON|OFF
MMEMory:SELect[:ITEM]:TRANsducer:ALL ON|OFF
```

RECALL

AUTO RECALL

```
MMEMory:LOAD:AUTO 1,<file_name>
```

DATA SET LIST

```
--
```

EDIT NAME

```
MMEMory:LOAD:STATe 1,<file_name>
```

EDIT PATH

The path is included in the file names.

DATA SET CLEAR

```
MMEMory:CLEar:STATe 1,<file_name>
```

DATA SET CLEAR ALL

```
MMEMory:CLEar:ALL
```

SELECT ITEMS TO RECALL

```
--
```

DEFAULT CONFIG

```
MMEMory:SELect[:ITEM]:DEFault
```

DISABLE ALL ITEMS

```
MMEMory:SELect[:ITEM]:NONE
```

ENABLE ALL ITEMS

```
MMEMory:SELect[:ITEM]:ALL
```

SELECT ITEMS

```
MMEMory:SELect[:ITEM]:GSETup ON|OFF
MMEMory:SELect[:ITEM]:HWSettings ON|OFF
MMEMory:SELect[:ITEM]:TRACe<1...4> ON|OFF
MMEMory:SELect[:ITEM]:LINes[:ACTive] ON|OFF
MMEMory:SELect[:ITEM]:LINes:ALL ON|OFF
MMEMory:SELect[:ITEM]:CSETup ON|OFF
MMEMory:SELect[:ITEM]:HCOPy ON|OFF
MMEMory:SELect[:ITEM]:CDATa ON|OFF
MMEMory:SELect[:ITEM]:MACRos ON|OFF
MMEMory:SELect[:ITEM]:SCData ON|OFF
MMEMory:SELect[:ITEM]:TRANsducer[:ACTive] ON|OFF
MMEMory:SELect[:ITEM]:TRANsducer:ALL ON|OFF
```

3.9.2.7 USER Key Group

MACRO 1...7	no corresponding IEC/IEEE-bus command
DEFINE MACRO	no corresponding IEC/IEEE-bus command
RECORD ON/OFF	no corresponding IEC/IEEE-bus command
DEFINE PAUSE	no corresponding IEC/IEEE-bus command
DELETE MACRO	no corresponding IEC/IEEE-bus command
MACRO TITLE	no corresponding IEC/IEEE-bus command
SELECT MACRO	no corresponding IEC/IEEE-bus command

3.9.3 Vector Signal Analysis Mode (Option FSE-B7)

3.9.3.1 CONFIGURATION Key Group – Digital Demodulation

MODE –

VECTOR ANALYZER --

DIGITAL DEMOD
```
INSTrument[:SELect]   DDEMod
[SENSe:]DDEMod:FORMat   QPSK | PSK | MSK |QAM | FSK
[SENSe:]DDEMod:QPSK:FORMat NORMal | DIFFerential | OFFSet | DPI4
[SENSe:]DDEMod:PSK:NSTate   2 | 8
[SENSe:]DDEMod:PSK:FORMat   NORMal | DIFFerential
[SENSe:]DDEMod:MSK:FORMat   TYPE1 | TYPE2 | NORMal | DIFFerential
[SENSe:]DDEMod:QAM:NSTate   16
[SENSe:]DDEMod:FSK:NSTate   2 | 4
```

DIGITAL STANDARD
```
[SENSe:]DDEMod:PRESet
              GSM| FNADc | RNADc| TETRa| DCS1800| PCS1900| PHS|
              PDCup | PDCDown | APCO25CQPSK | APCO25C4FM|
              CDPD| DECT| CT2| ERMes| MODacom| PWT| TFTS| F16| F322|
              F324|F64| FQCDMA| RQCDMA
```

MODULATION PARAMETERS --

SYMBOL RATE
```
[SENSe:]DDEMod:SRATe <numeric_value>
```

SIDE BAND
```
SENSe:DDEMod:SBANd NORMal|INVerse
```

MEAS FILTER
```
[SENSe:]DDEMod:FILTer:MEASurement    OFF| RCOSine| RRCosine| GAUSsian
```

REFERENCE FILTER
```
[SENSe:]DDEMod:FILTer:REFerence      RCOSine | RRCosine | GAUSsian
```

ALPHA/BT
```
[SENSe:]DDEMod:FILTer:ALPHa <numeric_value>
```

FSK REF DEVIATION
```
CALCulate<1|2>:FSK:DEViation:REFerence <numeric_value>
```

NORMALIZE
```
[SENSe:]DDEMod:NORMalize ON | OFF
```

MEAS RESULT --

MAGNITUDE CAP BUFFER
```
CALCulate<1|2>:FEED  'TCAP'
```

MEAS SIGNAL
```
CALCulate<1|2>:FEED  'XTIM:DDEM:MEAS'
```

REFERENCE SIGNAL
```
CALCulate<1|2>:FEED  'XTIM:DDEM:REF'
```

FREQUENCY	CALCulate<1|2>:FORMat FREQuency
MAGNITUDE	CALCulate<1|2>:FORMat MAGNitude
PHASE	CALCulate<1|2>:FORMat PHASe
PHASE WRAP ON/OFF	CALCulate<1|2>:FORMat PHASe | UPHase
REAL/IMAG PART	CALCulate<1|2>:FORMat RIMag
EYE DIAG [I]	CALCulate<1|2>:FORMat IEYE
EYE DIAG [Q]	CALCulate<1|2>:FORMat QEYE
EYE DIAG TRELLIS	CALCulate<1|2>:FORMat TEYE
EYE LENGTH	DISPlay[:WINDow<1|2>]:TRACe<1...4>:EYE:COUNt <numeric_value>
POLAR [IQ] CONSTELL	CALCulate<1|2>:FORMat CONS
POLAR [IQ] VECTOR	CALCulate<1|2>:FORMat COMP
SYMBOL DISPLAY	CALCulate<1|2>:FEED 'XTIM:DDEM:SYMB'
EYE DIAG [FREQ]	CALCulate<1|2>:FORMat FEYE
EYE LENGTH	CALCulate<1|2>:FORMat FREQuency
FREQUENCY	CALCulate<1|2>:FORMat MAGNitude
MAGNITUDE	CALCulate<1|2>:FORMat MAGNitude
SYMBOL DISPLAY	CALCulate<1|2>:FEED 'XTIM:DDEM:SYMB'
ERROR SIGNAL	CALCulate<1|2>:FEED 'XTIM:DDEM:ERR:MPH'
FREQUENCY	CALCulate<1|2>:FORMat FREQuency
MAGNITUDE	CALCulate<1|2>:FORMat MAGNitude
PHASE	CALCulate<1|2>:FORMat PHASe

REAL/IMAG PART	CALCulate<1|2>:FORMat RIMag
ERROR SIGNAL	CALCulate<1|2>:FEED 'XTIM:DDEM:ERR:MPH'
ERROR VECT MAGNITUDE	CALCulate<1|2>:FEED 'XTIM:DDEM:ERR:VECT'
MAGNITUDE	CALCulate<1|2>:FORMat MAGNitude
POLAR [IQ] CONSTELL	CALCulate<1|2>:FORMat CONS
POLAR [IQ] VECTOR	CALCulate<1|2>:FORMat COMP
SYMB TABLE / ERRORS	CALCulate<1|2>:FEED 'XTIM:DDEM:SYMB'
MEMORY SIZE	[SENSe:]TCAPture:LENGth 1024 | 2048 | 4096 | 8192 | 16384
FRAME LENGTH	[SENSe:]DDEMod:SEARch:TIME <numeric_value>
RESULT LENGTH	[SENSe:]DDEMod:TIME <numeric_value>
POINTS PER SYMBOL	[SENSe:]DDEMod:PRATe 1| 2| 4| 8| 16

3.9.3.2 CONFIGURATION Key Group – Analog Demodulation

MODE	–
VECTOR ANALYZER	--
ANALOG DEMOD	INSTrument[:SELect] ADEMod
MODULATION PARAMETER	--
HIGH PASS AFFILTER	SENSe:FILTer:HPASs[:STATe] ON|OFF SENSe:FILTer:HPASs:FREQuency <numeric_value>
LOW PASS AF FILTER	SENSe:FILTer[:LPASs][:STATe] ON|OFF SENSe:FILTer[:LPASs]:FREQuency <numeric_value>
WEIGHTING AF FILTER	SENSe:FILTer:CCITt[:STATe] ON|OFF SENSe:FILTer:CMESsage[:STATe] ON|OFF
AF COUPL'G AC DC	SENSe:ADEMod:AF:COUPling AC|DC
SQUELCH ON OFF	SENSe:ADEMod:SQUelch[:STATe] ON|OFF

SQUELCH LEVEL	SENSe:ADEMod:SQUelch:LEVel <numeric_value>
SIDE BAND NORM INV	SENSe:ADEMod:SBANd NORMal|INVerse
AM/FM DEEMPH	SENSe:FILTer:DEMPhasis:TCONstant <numeric_value>
PRE DISPL ON OFF	SENSe:FILTer:DEMPhasis:LINK DISPlay|AUDio
DEEMPHASIS ON OFF	SENSe:FILTer:DEMPhasis[:STATe] ON|OFF
MEAS RESULT	--
AM SIGNAL	CALCulate<1|2>:FEED 'XTIM:AM'
FM SIGNAL	CALCulate<1|2>:FEED 'XTIM:FM'
PM SIGNAL	CALCulate<1|2>:FEED 'XTIM:PM'
MODULATION SUMMARY	CALCulate<1|2>:FEED 'XTIM:AMSummary' CALCulate<1|2>:FEED 'XTIM:FMSummary' CALCulate<1|2>:FEED 'XTIM:PMSummary' CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:AM[:RESult?] PPEak | MPEak | MIDDle | RMS CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:FM[:RESult?] PPEak | MPEak | MIDDle | RMS | RDEV CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:PM[:RESult?] PPEak | MPEak | MIDDle | RMS CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:AFRequency[:RESult?] CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:FERRor [:RESult?] CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:SINad:RESult? CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:CARRier[:RESult?]
SUMMARY SETTINGS	--
AVERAGE HOLD ON	SENSe:MSUMmary:AHOLd[:STATe] ON|OFF
SWEEP COUNT	[SENSe:]SWEep:COUNt <numeric_value>
RELUNIT DB %	CALCulate<1|2>:UNIT:POWer DB|PCT
INDICATION ABS REL	SENSe:MSUMmary:MODE ABSolute | RELative
SET REFERENCE	SENSe:MSUMmary:REFerence <numeric_value>
MEAS-> REF	SENSe:MSUMmary:REFerence:AUTO ONCe
MEAS TIME	SENSe:MSUMmary:MTIMe <numeric_value>
SINAD 1kHz ON OFF	CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:SINad[:STATe] CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:SINad:RESult?

REAL TIME ON OFF	SENSe:ADEMod:RTIMe[:STATe] ON|OFF
SENSITIV AF OUTPUT	OUTPut:AF:SENSitivity <numeric_value>
VOLUME	SYSTem:SPEaker:VOLume <numeric_value>
DEMOD BANDWIDTH	SENSe:BANDwidth|BWIDth:DEMod <numeric_value>

3.9.3.3 FREQUENCY Key Group

CENTER	[SENSe:]FREQuency:CENTer <numeric_value>
FREQUENCY OFFSET	[SENSe:]FREQuency:OFFSet <numeric_value>

3.9.3.4 LEVEL Key Group

REF	--
REF LEVEL	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RLEVel <numeric_value>
RANGE	--
REF VALUE X AXIS	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:RVALue <numeric_value>
REF VALUE Y AXIS	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue <numeric_value>
Y PER DIV	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:PDIVision <numeric value>
REF VALUE POSITION	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RPOSition 0...100PCT
TIME/DIV	DISPlay[:WINDow<1|2>]:TRACe<1...4>:X[:SCALe]:TPDivision <numeric_value>
SCALE UNIT	CALCulate<1|2>:UNIT:POWer DBM| V| W| DB| PCT| UNITLESS| DBPW| WATT| DBUV| DBMV | VOLT| DBUA| AMPere
SENSITIV AF OUTPUT	OUTPut:AF:SENSitivity <numeric_value>
VOLUME	SYSTem:SPEaker:VOLume <numeric_value>

3.9.3.5 INPUT Key Group

INPUT	
RF ATTEN MANUAL	INPut:ATTenuation <numeric_value>
ATTEN AUTO LOW DIST	INPut:ATTenuation:AUTO:MODE LDIStortion; INPut:ATTenuation:AUTO ON
ATTEN AUTO LOW NOISE	INPut:ATTenuation:AUTO:MODE LNOise; INPut:ATTenuation:AUTO ON
ATTEN AUTO NORMAL	INPut:ATTenuation:AUTO:MODE NORMal; INPut:ATTenuation:AUTO ON
MIXER LEVEL	INPut:MIXer <numeric value>
INPUT SELECT	--
RF INPUT 50 OHM	INPut:IMPedance 50
RF INPUT 75 OHM/RAM	INPut:IMPedance:CORRection RAM
RF INPUT 75OHM/RAZ	INPut:IMPedance:CORRection RAZ

3.9.3.6 MARKER Key Group

NORMAL	
MARKER 1..2	CALCulate<1|2>:MARKer<1...2>[:STATe] ON | OFF; CALCulate<1|2>:MARKer<1...2>:X <numeric value>; CALCulate<1|2>:MARKer<1...2>:Y?
COUPLED MARKER	CALCulate<1|2>:MARKer<1...2>:COUPling[:STATe] ON | OFF
POLAR MARKER DEG/ RAD	CALCulate<1|2>:UNIT:ANGLe DEG | RAD
POLAR MARKER R/I / MA/PH	CALCulate<1|2>:MARKer<1...2>:READout MPHase | RIMaginary
ALL MARKER OFF	CALCulate<1|2>:MARKer<1...2>:AOFF
MARKER INFO	CALCulate<1|2>:MARKer<1...2>:FUNCtion:DDEMod:RESult? MERM| MEPK| MEPS| PERM| PEPK| PEPS| EVRM| EVPK| EVPS| IQOF| IQIM| ADR| FERR| DEV| FSRM| FSPK| FSPS| RHO| FEPK CALCulate<1|2>:MARKer<1...2>:FUNCtion:SUMMary:MAXimum:RESult? CALCulate<1|2>:MARKer<1...2>:FUNCtion:SUMMary:PPEak:RESult? CALCulate<1|2>:MARKer<1...2>:FUNCtion:SUMMary:MPEak:RESult? CALCulate<1|2>:MARKer<1...2>:FUNCtion:SUMMary:MIDDle:RESult? CALCulate<1|2>:MARKer<1...2>:FUNCtion:SUMMary:RMS:RESult? CALCulate<1|2>:MARKer<1...2>:FUNCtion:SUMMary:MEAN:RESult?

DELTA	
ALL DELTA OFF	CALCulate<1|2>:DELTamarker<1...4>[:STATe] ON | OFF CALCulate<1|2>:DELTamarker<1...4>:X <numeric value> CALCulate<1|2>:DELTamarker<1...4>:Y?
DELTA 1/2	CALCulate<1|2>:DELTamarker<1...4>:AOFF
DELTA ABS / REL	CALCulate<1|2>:DELTamarker<1...4>:MODE ABSolute | RELative
MARKER SEARCH	
ACTIVE MKR / DELTA	--
MIN	CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK] CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]
SEARCH LIMIT ON/OFF	CALCulate<1|2>:MARKer<1...4>:X:SLIMits[STATe] ON | OFF
SELECT MARKER	
SUMMARY MARKER	--
+PEAK	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PPEak:RESult?
-PEAK	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MPEak[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MPEak:RESult?
±PEAK/2	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MIDDle[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MIDDle:RESult?
RMS	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:RMS:RESult?
MAX |PEAK|	CALCulate<1|2>:MARKer<1..4>:FUNCtion:SUMMary:MAXimum[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...2>:FUNCtion:SUMMary:MAXimum:RESult?
ALL SUM MKR OFF	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:AOFF
AVERAGE ON / OFF	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:AVERage ON | OFF
MEAN	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN[:STATe] ON | OFF CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:MEAN:RESult?
PEAK HOLD ON / OFF	CALCulate<1|2>:MARKer<1...4>:FUNCtion:SUMMary:PHOLd ON | OFF
SWEEP COUNT	[SENSe:]SWEep:COUNt <numeric_value>

MKR ->

ACTIVE MKR / DELTA — no corresponding IEC/IEEE-bus command

MKR → TRACE

```
CALCulate<1|2>:MARKer<1...4>:TRACe <numeric value>
```

3.9.3.7 LINES Key Group

D LINES —

DISPLAY LINE 1/2

```
CALCulate:DLINe<1|2>:STATe  ON | OFF;
CALCulate:DLINe<1|2> <numeric_value>
```

REFERENCE LINE

```
CALCulate:RLINe:STATe ON | OFF;
CALCulate:RLINe <numeric_value>
```

THRESHOLD LINE

```
CALCulate:THReshold ON | OFF;
CALCulate:THReshold <numeric_value>
```

TIME LINE 1/2

```
CALCulate:TLINe<1|2>:STATe ON | OFF;
CALCulate:TLINe<1|2> <numeric_value>
```

LIMITS

SELECT LIMIT LINE

```
CALCulate<1|2>:LIMit<1...8>:NAME <string>;
CALCulate<1|2>:LIMit<1...8>:STATe ON | OFF
```

COPY LIMIT LINE

```
CALCulate<1|2>:LIMit<1...8>:COPY 1...8 | <name>
```

DELETE LIMIT LINE

```
CALCulate<1|2>:LIMit<1...8>:DELete
```

X OFFSET

```
CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFset <numeric_value>
```

Y OFFSET

```
CALCulate<1|2>:LIMit<1...8>:UPPer:OFFset <numeric_value>
CALCulate<1|2>:LIMit<1...8>:LOWer:OFFset <numeric_value>
```

EDIT LIMIT LINE

```
CALCulate<1|2>:LIMit<1...8>:UNIT  DBM| DBPW| WATT| DBUV | DBMV | VOLT |
                                  DBUA | AMPere| DB|
                                  DBUV_MHZ| DBMV_MHZ | DBUA_MHZ|
                                  DEG| RAD| S| HZ| PCT
CALCulate<1|2>:LIMit<1...8>:CONTrol[:DATA] <num_value>,<num_value>..
CALCulate<1|2>:LIMit<1...8>:CONTrol:DOMain   FREQuency|TIME
CALCulate<1|2>:LIMit<1...8>:CONTrol:OFFset <numeric_value>
CALCulate<1|2>:LIMit<1...8>:CONTrol:MODE   RELative | ABSolute
CALCulate<1|2>:LIMit<1...8>:CONTrol:UNIT[:TIME] S | SYM
CALCulate<1|2>:LIMit<1...8>:UPPer[:DATA] <num_value>,<num_value>..
CALCulate<1|2>:LIMit<1...8>:UPPer:STATe   ON | OFF
CALCulate<1|2>:LIMit<1...8>:UPPer:OFFset <numeric_value>
CALCulate<1|2>:LIMit<1...8>:UPPer:MARGin <numeric_value>
CALCulate<1|2>:LIMit<1...8>:UPPer:MODE   RELative | ABSolute
CALCulate<1|2>:LIMit<1...8>:LOWer[:DATA] <num_value>,<num_value>..
CALCulate<1|2>:LIMit<1...8>:LOWer:STATe ON | OFF
CALCulate<1|2>:LIMit<1...8>:LOWer:OFFset <numeric_value>
CALCulate<1|2>:LIMit<1...8>:LOWer:MARGin <numeric_value>
CALCulate<1|2>:LIMit<1...8>:LOWer:MODE   RELative | ABSolute
```

NEW LIMIT LINE	s. EDIT LIMIT LINE
NAME	CALCulate<1|2>:LIMit<1...8>:NAME <string>
VALUES	no corresponding IEC/IEEE-bus command
DELETE VALUE	no corresponding IEC/IEEE-bus command
INSERT VALUE	no corresponding IEC/IEEE-bus command
SAVE LIMIT LINE	automatically executed during IEC/IEEE-bus operation
SHIFT X LIMIT LINE	CALCulate<1|2>:LIMit<1...8>:CONTrol:SHIFt <numeric_value>
SHIFT Y LIMIT LINE	CALCulate<1|2>:LIMit<1...8>:UPPer:SHIFt <numeric_value> CALCulate<1|2>:LIMit<1...8>:LOWer:SHIFt <numeric_value>

3.9.3.8 TRACE Key Group

TRACE	--
BLANK	DISPlay[:WINDow<1|2>]:TRACe<1...4>[:STATe] OFF
CLEAR/WRITE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE WRITe
CONTINUOUS WRITE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE:CWRite ON|OFF
VIEW	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE VIEW
AVERAGE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE AVERage
MAX HOLD	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE MAXHold
MIN HOLD	DISPlay[:WINDow<1|2>]:TRACe<1...4>:MODE MINHold
SWEEP COUNT	[SENSe:]SWEep:COUNt <numeric_value>

3.9.3.9 SWEEP Key Group

COUPLING	--
ANALOG BW AUTO	[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO ON | OFF
ANALOG BW MANUAL	[SENSe:]BANDwidth|BWIDth[:RESolution] <numeric_value>
MAIN PLL BANDWIDTH	[SENSe:]BANDwidth|BWIDth:PLL AUTO|HIGH|MEDium|LOW
SWEEP	
CONTINUOUS SWEEP	INITiate:CONTinuous ON
RESULT LENGTH	[SENSe:]DDEMod:TIME <numeric_value>
SINGLE SWEEP	INITiate:CONTinuous OFF
SWEEP COUNT	[SENSe:]SWEep:COUNt <numeric_value>

3.9.3.10 SWEEP Key Group - Digital Demodulation

TRIGGER	
FREE RUN	TRIGger[:SEQuence]:SOURce IMMediate
SLOPE POS/NEG	TRIGger[:SEQuence]:SLOPe POSitive|NEGative
VIDEO	TRIGger[:SEQuence]:SOURce VIDeo TRIGger[:SEQuence]:LEVel:VIDeo <numeric value>
FIND BURST	[SENSe:]DDEMod:SEARch:PULSe:STATe ON | OFF
FIND SYNC ON/OFF	[SENSe:]DDEMod:SEARch:SYNC:STATe ON | OFF
SYNC OFFSET	[SENSe:]DDEMod:SEARch:SYNC:OFFSET <numeric_value>

SYNC PATTERN	--
DELETE PATTERN	--
SELECT PATTERN	--
SYNC PATTERN	-
COMMENT	-
NAME	- -
NEW SYNC PATTERN	[SENSe:]DDEMod:SEARch:SYNC:PATTern <string>
SAVE PATTERN	automatically executed during IEC/IEEE-bus operation
VALUE	[SENSe:]DDEMod:SEARch:SYNC:PATTern <string>
EDIT SYNC PATTERN	[SENSe:]DDEMod:SEARch:SYNC:PATTern <string>

3.9.3.11 SWEEP Key Group - Analog Demodulation

TRIGGER	
FREE RUN	TRIGger[:SEQuence]:SOURce IMMediate
VIDEO	TRIGger[:SEQuence]:SOURce VIDeo TRIGger[:SEQuence]:LEVel:VIDeo <numeric value>
EXTERN	TRIGger[:SEQuence]:SOURce EXTernal TRIGger[:SEQuence]:LEVel[:EXTernal] <numeric value>
AF SIGNAL	TRIGger[:SEQuence]:SOURce AF
SLOPE POS/NEG	TRIGger[:SEQuence]:SLOPe POSitive|NEGative
TRIGGER OFFSET	TRIGger[:SEQuence]:HOLDoff <numeric_value>

3.9.4 Tracking Generator Mode (Option FSE-B8...B11)

3.9.4.1 CONFIGURATION Key Group

MODE	
TRACKING GEN	--
PWR OFFSET	SOURce:POWer[:LEVel][:IMMediate]:OFFSet <numeric value>
SOURCE ON/OFF	OUTPut:[:STATe] ON | OFF
SOURCE PWR	SOURce:POWer[:LEVel][:IMMediate][:AMPLitude] <numeric value>
SOURCE CAL	--
NORMALIZE	[SENSe:]CORRection[:STATe] ON | OFF
REF VALUE POSITION	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RPOSition 0...100PCT
REF VALUE	DISPlay[:WINDow<1|2>]:TRACe<1...4>:Y[:SCALe]:RVALue <numeric_value>
CAL TRANS	[SENSe:]CORRection:METHod TRANsmission [SENSe:] CORRection:COLLect[:ACQuire] THRough
CAL REFL OPEN	[SENSe:]CORRection:METHod REFLexion [SENSe:]CORRection:COLLect[:ACQuire] OPEN
CAL REFL SHORT	[SENSe:]CORRection:METHod REFLexion [SENSe:]CORRection:COLLect[:ACQuire] THRough
RECALL	[SENSe:]CORRection:RECall
FREQUENCY OFFSET	SOURce:FREQuency:OFFSet <numeric value>
MODULATION	--
EXT ALC	SOURce:POWer:ALC:SOURce INTernal | EXTernal
EXT AM	SOURce:AM:STATe ON | OFF
EXT FM	SOURce:FM:STATe ON | OFF
EXT I/Q	SOURce:DM:STATe ON | OFF

3.9.5 TV-Demodulation Mode (Option FSE-B3)

3.9.5.1 CONFIGURATION Key Group

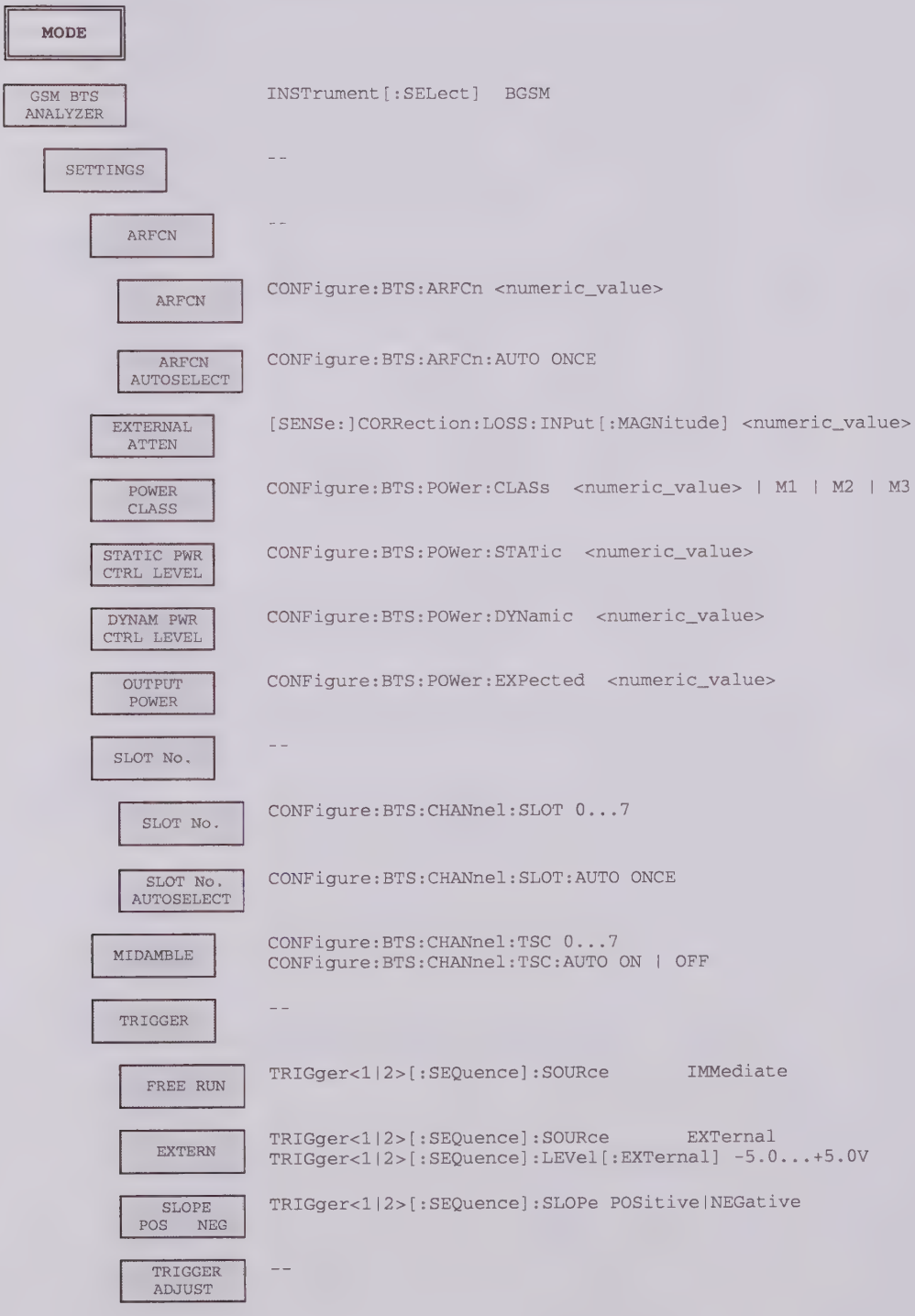
MODE	
TV DEMOD	[SENSe:]TV[:STATe] ON | OFF
525 LINE SYSTEM	TRIGger[:SEQuence]:VIDeo:FORMat:LPFRame 525
625 LINE SYSTEM	TRIGger[:SEQuence]:VIDeo:FORMat:LPFRame 625
PICT/SOUND OFFSET	[SENSe:]TV:PSOFfset <numeric_value>
TV DEMOD OFF	[SENSe:]TV[:STATe] ON | OFF
VIDEO POL NEGATIVE	TRIGger[:SEQuence]:VIDeo:SSIGnal:POLarity NEGative
VIDEO POL POSITIVE	TRIGger[:SEQuence]:VIDeo:SSIGnal:POLarity POSitive

3.9.5.2 SWEEP Key Group

TRIGGER	
TV	TRIGger[:SEQuence]:SOURce TV
TV TRIGGER SETTINGS	--
VERT SYNC	TRIGger[:SEQuence]:VIDeo:FIELd:SELect ALL
HOR SYNC	TRIGger[:SEQuence]:VIDeo:LINE:NUMBer <numeric_value>
VERT SYNC EVEN FIELD	TRIGger[:SEQuence]:VIDeo:FIELd:SELect EVEN
VERT SYNC ODD FIELD	TRIGger[:SEQuence]:VIDeo:FIELd:SELect ODD

3.9.6 GSM BTS Analysis Mode (Option FSE-K11)

3.9.6.1 CONFIGURATION Key Group



FRAME COARSE	TRIGger[:SEQuence]:SYNChronize:ADJust:FRAMe <numeric_value>
FRAME FINE	TRIGger[:SEQuence]:SYNChronize:ADJust:FRAMe <numeric_value>
AUTO FRAME ADJUST	TRIGger[:SEQuence]:SYNChronize:ADJust:FRAMe:AUTO ONCE
SLOT ADJUST	TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT <numeric_value>
AUTO SLOT ADJUST	TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT:AUTO ONCE
DEFAULT SETTINGS	CONFigure:BTS:PRESet
P-GSM 900	CONFigure:BTS:NETWork[:TYPE] PGSM
E-GSM 900	CONFigure:BTS:NETWork[:TYPE] EGSM
DCS 1800	CONFigure:BTS:NETWork[:TYPE] DCS
PCS 1900	CONFigure:BTS:NETWork[:TYPE] PCS
PHASE II I	CONFigure:BTS:NETWork:PHASe 1|2
LIMIT MARGIN	CALCulate<1|2>:LIMit<1...8>:MARGin <numeric_value>
SPURIOUS	CONFigure:SPURious[:IMMediate] CALCulate:LIMit:SPURious? TXBand | OTXBand | RXBand CALCulate:LIMit:SPURious:FAILs? TXBand | OTXBand | RXBand
START LIST	READ:SPUR[:ALL]?
START LIST SGL STEP	ABORT;READ:SPUR:STEP?
CONT SGL STEP LIST	READ:SPUR:STEP?
TX SUPPR ON OFF	CONFigure:BTS:TXSupp ON | OFF
RX BAND GAIN	[SENSe:]CORRection:RXGain:INPut[:MAGNitude] <numeric_value>
SWEEP COUNT	CONFigure:SPURious:COUNt <numeric_value>
SWP COUNT TX / <> TX	CONFigure:SPURious:RANGe TXBand | OTXBand
SWP COUNT RX BAND	CONFigure:SPURious:RANGe RXBand
SET TO STANDARD	--

TX BAND	CONFigure:SPURious:RANGe TXBand
<> TX BAND	CONFigure:SPURious:RANGe OTXBand
RX BAND	CONFigure:SPURious:RANGe RXBand
BTS SFH ON OFF	CONFigure:BTS:CHANnel:SFH ON | OFF
COSITING	CONFigure:BTS:COSiting ON | OFF
TRANSIENT SPECTRUM	CONFigure:SPECtrum:SWITching[:IMMediate] CALCulate:LIMit:SPECtrum:SWITching? ARFCn|TXBand|RXBand|COMBined CALCulate:LIMit:SPECtrum:SWITching:FAILs? ARFCn|TXBand|RXBand|COMBined
SINGLE FREQ SWEEP	INITiate:CONTinuous OFF; INITiate [:IMMediate]
CONTINUOUS FREQ SWEEP	INITiate:CONTinuous ON; INITiate [:IMMediate]
START LIST	READ:SPECtrum:SWITching[:ALL]?
NO. OF BURSTS	--
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	--
BTS SFH ON OFF	CONFigure:BTS:CHANnel:SFH ON | OFF
MODULATION SPECTRUM	CONFigure:SPECtrum:MODulation[:IMMediate] CALCulate:LIMit:SPECtrum:MODulation? ARFCn|TXBand|RXBand|COMBined CALCulate:LIMit:SPECtrum:MODulation:FAILs? ARFCn|TXBand|RXBand|COMBined CALCulate:LIMit:SPECtrum:MODulation:EXCeptions? ARFCn|TXBand|RXBand|COMBined
SINGLE FREQ SWEEP	INITiate:CONTinuous OFF; INITiate [:IMMediate]
CONTINUOUS FREQ SWEEP	INITiate:CONTinuous ON; INITiate [:IMMediate]
START LIST	READ:SPECtrum:MODulation[:ALL]?
NO. OF BURSTS	--
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	--
ARFCN ±1.8 MHZ	CONFigure:SPECtrum:MODulation:RANGe ARFCn

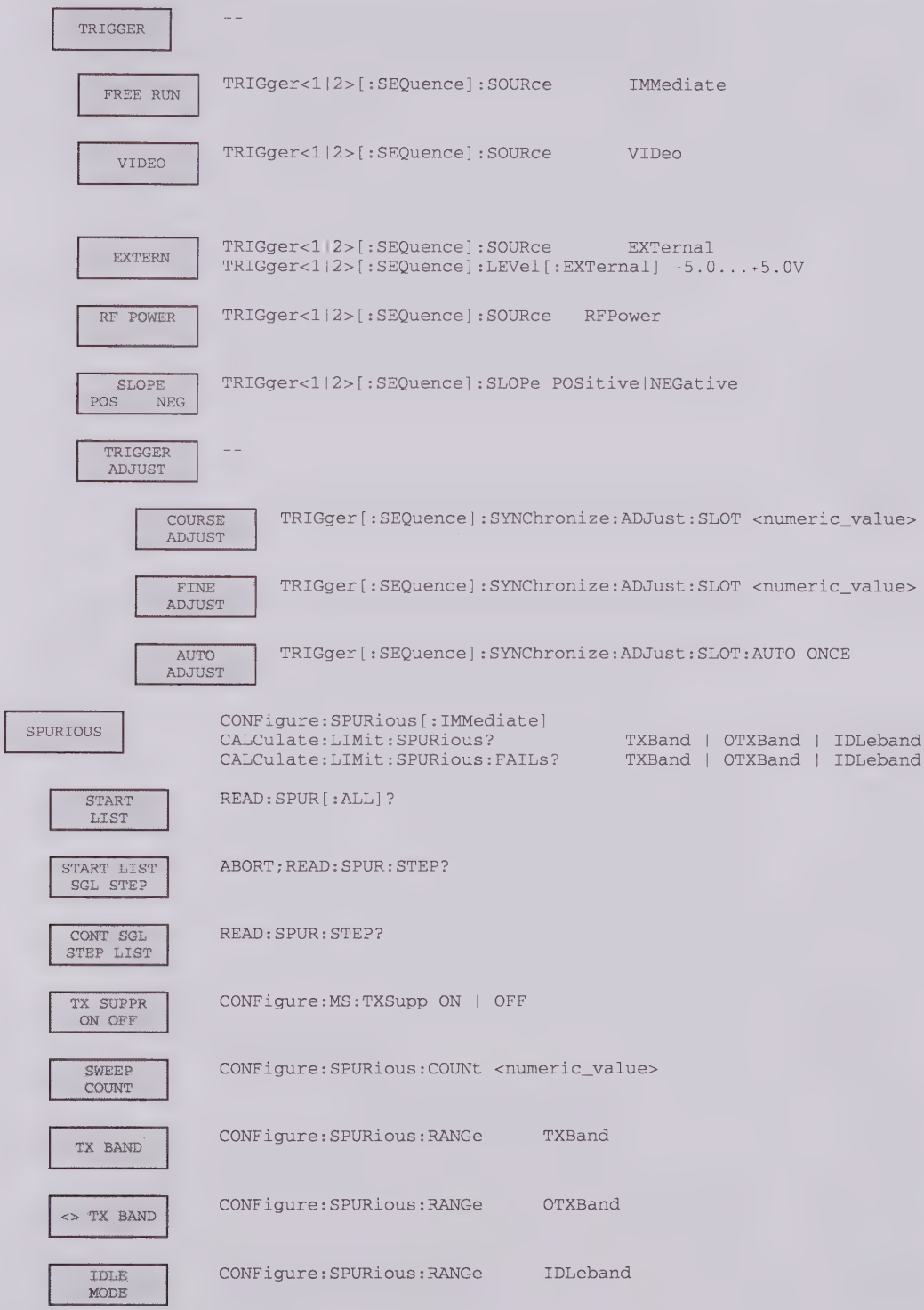
TX BAND	CONFigure:SPECtrum:MODulation:RANGe TXBand
±1.8 MHZ / TX BAND	CONFigure:SPECtrum:MODulation:RANGe COMBined
RX BAND	CONFigure:SPECtrum:MODulation:RANGe RXBand
RX BAND GAIN	[SENSe:]CORRection:RXGain:INPut[:MAGNitude] <numeric_value>
TRIGGER ADJUST	see SETTINGS submenu
POWER VS TIME	CONFigure: BURSt:PTEMplate[:IMMediate] CALCulate:LIMit:BURSt:PTEMplate?
SINGLE	INITiate:CONTinuous OFF; INITiate [:IMMediate]
CONTINUOUS	INITiate:CONTinuous ON; INITiate [:IMMediate]
FULL BURST	CONFigure: BURSt:PTEMplate:SELect FULL
BURST HIGH RESOLUTION	CONFigure: BURSt:PTEMplate:SELect TOP
RISING	CONFigure: BURSt:PTEMplate:SELect RISing
FALLING	CONFigure: BURSt:PTEMplate:SELect FALLing
MEAS BANDWIDTH	[SENSe:]BANDwidth|BWIDth[:RESolution] DEF | 300 kHz | 1 MHz
SYNC TO MIDAMBLE	TRIGger[:SEQuence]:SYNChronize:SOURce FRAMe | TSC
NO. OF BURSTS	--
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	--
TRIGGER ADJUST	see SETTINGS submenu
CARRIER POWER	CONFigure: BURSt:POWer[:IMMediate] CALCulate:LIMit:BURSt:POWer?
MEAS MAX OUTPUT PWR	READ:BURSt:POWer?
INC STATIC PWR CTRL	READ:BURSt:POWer:STATic?

INC DYNAM PWR CTRL	READ:BURSt:POWer:DYNamic?
NO. OF BURSTS	--
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	--
CONDITIONS NORM EXTR	CONFigure: BURSt:POWer:CONDition NORMal | EXTReme
SYNC TO MIDAMBLE	TRIGger[:SEQuence]:SYNChronize:SOURce FRAMe | TSC
TRIGGER ADJUST	see SETTINGS submenu
PHASE/FREQ ERROR	CONFigure: BURSt:PFERror[:IMMediate]
SINGLE	INITiate:CONTinuous OFF; INITiate [:IMMediate]
CONTINUOUS	INITiate:CONTinuous ON; INITiate [:IMMediate]
NO. OF BURSTS	--
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	--

3.9.7 GSM MS Analysis Mode (Option FSE-K10)

3.9.7.1 CONFIGURATION Key Group

MODE	
GSM MS ANALYZER	INSTrument[:SELect] MGSM
SETTINGS	--
ARFCN	CONFigure:MS:ARFCn <numeric_value>
ARFCN AUTOSELECT	CONFigure:MS:ARFCn:AUTO ONCE
EXTERNAL ATTEN	[SENSe:]CORRection:LOSS:INPut[:MAGNitude] <numeric_value>
POWER CLASS	CONFigure:MS:POWer:CLASs <numeric_value>
PWR CTRL LEVEL	CONFigure:MS:POWer:LEVel <numeric_value>
DEFAULT SETTINGS	CONFigure:MS:PRESet
OUTPUT POWER	CONFigure:MS:POWer:EXPected <numeric_value>
MIDAMBLE	CONFigure:MS:CHANnel:TSC 0...7
P-GSM 900	CONFigure:MS:NETWork[:TYPE] PGSM
E-GSM 900	CONFigure:MS:NETWork[:TYPE] EGSM
DCS 1800	CONFigure:MS:NETWork[:TYPE] DCS
PCS 1900	CONFigure:MS:NETWork[:TYPE] PCS
PHASE II I	CONFigure:MS:NETWork:PHASe 1|2
LIMIT MARGIN	CALCulate<1|2>:LIMit<1...8>:MARGin <numeric_value>


TRIGGER
--
FREE RUN
TRIGger<1|2>[:SEQuence]:SOURce IMMediate
VIDEO
TRIGger<1|2>[:SEQuence]:SOURce VIDeo
EXTERN
TRIGger<1|2>[:SEQuence]:SOURce EXTernal
TRIGger<1|2>[:SEQuence]:LEVel[:EXTernal] -5.0...+5.0V
RF POWER
TRIGger<1|2>[:SEQuence]:SOURce RFPower
SLOPE
POS NEG
TRIGger<1|2>[:SEQuence]:SLOPe POSitive|NEGative
TRIGGER ADJUST
--
COURSE ADJUST
TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT <numeric_value>
FINE ADJUST
TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT <numeric_value>
AUTO ADJUST
TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT:AUTO ONCE
SPURIOUS
CONFigure:SPURious[:IMMediate]
CALCulate:LIMit:SPURious? TXBand | OTXBand | IDLeband
CALCulate:LIMit:SPURious:FAILs? TXBand | OTXBand | IDLeband
START LIST
READ:SPUR[:ALL]?
START LIST SGL STEP
ABORT;READ:SPUR:STEP?
CONT SGL STEP LIST
READ:SPUR:STEP?
TX SUPPR ON OFF
CONFigure:MS:TXSupp ON | OFF
SWEEP COUNT
CONFigure:SPURious:COUNt <numeric_value>
TX BAND
CONFigure:SPURious:RANGe TXBand
<> TX BAND
CONFigure:SPURious:RANGe OTXBand
IDLE MODE
CONFigure:SPURious:RANGe IDLeband

TRANSIENT SPECTRUM	CONFigure:SPECtrum:SWITching[:IMMediate] CALCulate:LIMit:SPECtrum:SWITching? ARFCn|TXBand|RXBand|COMBined CALCulate:LIMit:SPECtrum:SWITching:FAILs? ARFCn|TXBand|RXBand|COMBined
SINGLE FREQ SWEEP	INITiate:CONTinuous OFF; INITiate [:IMMediate]
CONTINUOUS FREQ SWEEP	INITiate:CONTinuous ON; INITiate [:IMMediate]
START LIST	READ:SPECtrum:SWITching[:ALL]?
NO. OF BURSTS	--
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	--
TRIGGER ADJUST	see SETTINGS submenu
MODULATION SPECTRUM	CONFigure:SPECtrum:MODulation[:IMMediate] CALCulate:LIMit:SPECtrum:MODulation? ARFCn|TXBand|RXBand|COMBined|DCSRx1800 CALCulate:LIMit:SPECtrum:MODulation:FAILs? ARFCn|TXBand|RXBand|COMBined|DCSRx1800 CALCulate:LIMit:SPECtrum:MODulation:EXCeptions? ARFCn|TXBand|RXBand|COMBined|DCSRx1800
SINGLE FREQ SWEEP	INITiate:CONTinuous OFF; INITiate [:IMMediate]
CONTINUOUS FREQ SWEEP	INITiate:CONTinuous ON; INITiate [:IMMediate]
START LIST	READ:SPECtrum:MODulation[:ALL]?
NO. OF BURSTS	--
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	--
ARFCN ± 1.8 MHz	CONFigure:SPECtrum:MODulation:RANGe ARFCn
TX BAND	CONFigure:SPECtrum:MODulation:RANGe TXBand
±1.8 MHZ TX BAND	CONFigure:SPECtrum:MODulation:RANGe COMBined

RX BAND GSM 900	CONFigure:SPECtrum:MODulation:RANGe RXBand
RX BAND DCS 1800	CONFigure:SPECtrum:MODulation:RANGe DCSRx1800
TRIGGER ADJUST	see SETTINGS submenu
RX BAND GAIN	[SENSe:]CORRection:RXGain:INPut[:MAGNitude] <numeric_value>
POWER VS TIME	CONFigure: BURSt:PTEMplate[:IMMediate] CALCulate:LIMit:BURSt:PTEMplate?
SINGLE	INITiate:CONTinuous OFF; INITiate [:IMMediate]
CONTINUOUS	INITiate:CONTinuous ON; INITiate [:IMMediate]
FULL BURST	CONFigure: BURSt:PTEMplate:SELect FULL
BURST HIGH RESOLUTION	CONFigure: BURSt:PTEMplate:SELect TOP
RISING	CONFigure: BURSt:PTEMplate:SELect RISing
FALLING	CONFigure: BURSt:PTEMplate:SELect FALLing
MEAS BANDWIDTH	[SENSe:]BANDwidth|BWIDth[:RESolution] DEF | 300 kHz | 1 MHz
SYNC TO MIDAMBLE	TRIGger[:SEQuence]:SYNChronize:SOURce FRAMe | TSC
NO. OF BURSTS	--
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	--
TRIGGER ADJUST	see SETTINGS submenu
CARRIER POWER	CONFigure: BURSt:POWer[:IMMediate] CALCulate:LIMit:BURSt:POWer?
MEAS MAX OUTPUT PWR	READ:BURSt:POWer?
INC PWR CTRL LEVEL	READ:BURSt:POWer:LEVel?

NO. OF BURSTS	--
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	--
CONDITIONS NORM EXTR	CONFigure: BURSt:POWer:CONDition NORMal | EXTReme
SYNC TO MIDAMBLE	TRIGger[:SEQuence]:SYNChronize:SOURce FRAMe | TSC
TRIGGER ADJUST	see SETTINGS submenu
PHASE/FREQ ERROR	CONFigure: BURSt:PFERror[:IMMediate]
SINGLE	INITiate:CONTinuous OFF; INITiate [:IMMediate]
CONTINUOUS	INITiate:CONTinuous ON; INITiate [:IMMediate]
NO. OF BURSTS	
NO. OF BURSTS	CONFigure:SPECtrum:SWITching:COUNt <numeric_value>
SET TO STANDARD	-

4 Maintenance and Troubleshooting

4.1 Maintenance

4.1.1 Mechanical Maintenance

The FSE does not require any mechanical maintenance. The front panel can be cleaned from time to time using a damp, soft cloth.

4.1.2 Electrical Maintenance

4.1.2.1 Testing the Level Measuring Accuracy

Due to the total calibration facility by means of the built-in calibration generator, high long-term stability of the level measuring characteristics is guaranteed. It is recommended to check the measuring accuracy every two years according to section 5. Reprogramming of the correction data by a R&S servicing shop is necessary, if tolerances are exceeded.

4.1.2.2 Testing the Frequency Accuracy

The frequency accuracy of the reference oscillator is to be checked once a year according to section 5. It is not necessary to perform this test if the instrument is operated using an external reference.

Test utility: Frequency counter of signal generator

Test setup: Measurement with frequency counter
Connect frequency counter to the REF OUT/IN socket at the rear of the instrument.

Measurement with signal generator
Apply signal with 1GHz, -10dBm to RFin.

Measurement: Settings on FSE:

[CENTER	1000 MHz]
[SPAN	0 MHz]
[REF REF LEVEL	-10 dBm]
[MARKER COUNT	ON
COUNTER RESOL	0.1 Hz]

Activate internal frequency counter (marker function)

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4.2 Monitoring the Function of the FSE

4.2.1 Switch-on Test

Following switch-on of the instrument a selftest of the processor functions is executed first. Subsequently, the transputer net is initialized, which adopts control of the analog modules.

4.2.2 Monitoring of the Synthesizers and Signal Levels

The FSE is provided with a large amount of selftest points which can be switched to an A/D converter via multiplexer. Most of these test points are located on the analog modules and, by means of level detectors, allow for monitoring the levels in the signal path, the output levels of the LO drivers and the tuning voltages of the oscillators. The selftest voltages which are required for proper functioning, are additionally monitored by comparators. The output signals of these comparators are stored and checked by the level transputer during each request of a measured value. If one of these comparators responds, one of the following error messages is output:

Message	Meaning	see Section
Reference unlock	Reference osxillator not synchronized	"Error Messages of the Synthesizer"
LO UNL	First LO not synchronized	"Error Messages of the Synthesizer"
2nd/3rd LO unlock	Second and third LO not synchronized	"Error Messages of the Synthesizer"
Level 1st LO	LO level at first mixer too small	"Error Messages of the Synthesizer"
Level 2nd LO	LO level at second mixer too small	"Error Messages of the Synthesizer"
Level 3rd LO	LO level at third mixer too small	"Error Messages of the Synthesizer"
OVLD	Input signal too large	"Overload Messages"
IF OVLD	Signal following IF amplifier too large	"Overload Messages"

4.2.3 Error Messages of the Synthesizer

When the message LO UNL is displayed, the instrument continues operating, however, the signals indicated may have been shifted on the frequency axis. In particular, when the instrument is operated at about the maximum or minimum operating temperature, it may occur, after ageing of the analyzer, that the tuning voltage of the voltage-controlled oscillators drift at the limit of the permitted range. Therefore, correction of the pretuning is provided for the first LO (YIG oscillator) and the third LO (VCO) which is performed during total calibration of the instrument, thus eliminating the error. Correction is not required for the second LO, since it is obtained by multiplication of the third LO. For measuring accuracy reason, it is recommended with very cold or hot environment to call the total calibration of the instrument (after a warm-up period of at least 30 minutes).

When the message "Reference unlock" is output and if the analyzer is set to external reference, check that the latter is applied with the correct frequency and sufficient level at connector EXT REF IN/OUT. If the analyzer is set to internal reference, the message should only occur during a short warm-up phase following switch-on.
The message Level Lo means that the level at the LO gate of one of the mixers is too low, which may lead to dips in the conversion attenuation. In any case, this message indicates a fault inside the instrument.

4.2.4 Overload Messages

The messages OVLD and IF-OVLD indicate an overload in the signal path of the instrument. These messages are a warning that the analyzer indication will seem to be wrong, because one stage in the signal path is operated with the 1-dB compression or above.
The message OVLD indicates that one stage preceding the variable IF amplifier is operated with an exceeded level. The level can only be reduced by an increased attenuation of the input attenuator (RF Attenuation). Overload at the input mixer and in the subsequent stages frequently occurs, if pulsed or highly modulated signals are applied. Such signals have a high peak value compared to the input bandwidth and this may lead to compression of these stages.
If this message is output without an input signal being applied, the input mixer is defective. The LO feedthrough (= the level display with input frequency zero) depends to a large extent on the balance of the input mixer. Since a partially faulty mixer becomes very unbalanced, thus providing very high LO feedthrough, this may lead to overload of the subsequent stages and thus to output of the message OVLD.
The message IF-OVLD indicates compression in one stage following the switchable IF amplifier. This can be remedied even with fixed input attenuation by increasing the reference level. In analyzer mode, the IF amplification depends on the reference level and the RF attenuation.

4.3 Function Description of the Overall Instrument

4.3.1 Introduction

This section informs on the theory of operation of this instrument.

4.3.2 Modules of the Analog Unit

All modules of the analog unit contain an individually programmed EEPROM indicating the model and correction data, such as frequency response, filter parameters, insertion gain. The analog unit consists of the following modules:

- RF modules with RF converter and YIG sampler forming part of the RF module
- v MW converter modules (for instruments with a frequency range > 7 GHz)
- 2nd IF converter
- IF filter
- I/Q-demodulator (vector signal analyzer)
- Fracsyn with static transputer module
- Low phase noise for instrument model 30
- Detector board with dynamic transputer module and DSP module
- Analog motherboard

4.3.3 Modules of the Digital Unit

The boards of the digital unit do not contain any particular correction data. The digital unit is independent of the type of instrument, the only difference is the amount and type of plug-in boards fitted such as VGA board for the DOS option or a network board. The digital unit consists of the following modules:

- Main processor
- Graphic board
- Digital motherboard (containing the interface drivers such as IEC bus, LPT and COM)
- Hard disk
- Floppy disk
- LC display
- Keypad
- Option VGA board
- Option 2nd IEEE-bus
- Option LAN interface

4.3.4 Description of the Analog Unit

The FSE has been conceived as analyzer with triple conversion. Special importance has been attached to reaching high display dynamics, i.e., the individual amplifier stages have not only been trimmed to minimum displayed noise level but adjusted such that they provide good intermodulation characteristics with an acceptable noise factor.

The input signal passes a switchable input divider (attenuation range 0 to 70dB in steps of 10dB), which also switches the internal calibration and test signal.

In the RF converter, the signal is converted to the 1st IF (FSEA: 4.3414 GHz (FSEB: 7.9414 GHz) using the 1st LO (FSEA: 4.3414 to 7.8414 GHz, FSEB: 7.9414 to 14.9414 GHz) after having passed the input lowpass in the 1st mixer. Following the 1st IF filter and the IF gain, the signal is converted to the 2nd IF of 741.4MHz.
By those FSE models having a frequency range greater than 7 GHz, the signal is divided, after the input divider, in a switchable diplexer. The portions of the signal below 7 GHz are further processed in the RF converter. The portions of the signal above 7 GHz are fed via a YIG filter to the MW converter. The conversion of the IF of 741.4 MHz takes place in this module. The LO required for the conversion comes from the RF converter and, depending on the frequency range, is either fed directly or via a doubler to the mixer.
The next module in the signal path is the 2nd IF Converter, which provides for conversion of the second IF to the third IF of 21.4 MHz and generation of the second and third LO. Apart from several amplifiers it contains a filter on 741.4 MHz with a 3-dB bandwidth of 10 MHz. This filter serves as resolution filter if the resolution bandwidth is 10 MHz and it reflects the image frequency which might be generated by the third conversion.

The resolution filters for bandwidths between 1 kHz and 5 MHz are located on the IF filter board . With the 10-MHz bandwidth, the filter stages of the board are bypassed. Crystal filters are used for bandwidths between 1 and 30 kHz, LC filters are provided for bandwidths of 50 kHz or above. The individual filter stages have been decoupled from each other by means of amplifiers which is why they act as Gaussian filter. Subsequent to the first two filter stages, switchable IF amplifiers (Step Gain) and two independent calibration amplifiers are fitted. The step gain can be switched in 0.1-dB steps from 0 to 50 dB and is used to amplify the signal on the reference level. One of the two calibration amplifiers is used to compensate for the deviations of amplification with different bandwidth or step-gain settings. This amplifier is controlled via the serial interface of the level transputer and a D/A converter on the IF filter board. The second calibration amplifier is controlled by an analog voltage, which is modified by the frequency transputer during the sweep according to the frequency response of the input stages.

The IF filters are followed by the log module, which provides for a dynamic of 90 or 110 dB depending on the model. The video signal thus created is passed to the detector board. There, it is through-connected to the rear panel.
If resolution bandwidths are < 1kHz, the signal path via the log module remains unused. The signal is still filtered by the IF filter board to a bandwidth of 3 kHz, but then converted to a 25-kHz IF and filtered digitally on the module. An 18-bit A/D converter is provided on the digital IF for sampling with the 25-kHz IF.

A measuring A/D converter with a sampling rate of 20 MHz is provided on the detector board. Due to the high sampling rate of the A/D converter the analog peak detectors are not required, they are digitally simulated following the converter. Video filtering is carried out digitally, too, in the noise filter gate-array on the detector board. For video bandwidths ≤ 20 kHz, additional filtering is carried out using a DSP, which remains disabled above 20 kHz.

4.3.5 Processor Structure

Apart from a 80486 CPU, the FSE is provided with three T805-32-bit transputers and a 16-bit transputer T225. Two DSPs are provided in the basic instrument for digital signal processing.

The 80486 CPU controls the complete data exchange with the periphery, such as keybaord entry, representation of the softkeys and operation via the IEC bus. The transputers independently control the test procedure, calculate correction factors and display the measuring curve on the screen. The transputers are provided with the current instrument settings by the 80486 CPU via a link adapter, which connects the ISA bus of the CPU board with a transputer link of the T805 on the graphic board (called GTP = graphic transputer in the following). Other transputer links couple the T224 on the graphics board and the two T805 on the detector board (LTP = level transputer) and the Fracsyn (FTP = frequency transputer) to the GTP. T225 is exclusively used as interface between the GTP and the chipset for graphics.

4.3.5.1 Tasks of the Level Transputer

The PTP receives the level-dependent settings from the graphic transputer and causes the corresponding switchovers in the hardware to be made via a serial interface. The PTP has the following functions: making the level-dependent settings such as attenuation of the attenuator, the bandwidths on the IF filter and level correction with the calibration frequency (120 MHz) and, on the other hand, programming of the DSPs, obtaining the measured values and passing the measured values to the graphic transputer via the transputer link. To meet these requirements, the PTP is provided with its individual serial bus to those boards which require level-dependent settings. I.e., the modules IF filter, digital IF, attenuator control board.

4.3.5.2 Tasks of the Frequency Transputer

The FTP receives the current sweep setting from the graphic transputer via the PTP and calculates the required synthesizer settings. For settings which have to be made during a sweep, the FTP is fitted with a fast parallel bus on the fracsyn module, which also addresses the sweep synthesizer. The subsequent settings have to be made: the frequency-dependent level correction, coarse tuning of the YIG oscillator and control of the sweep output. The fracsyn module therefore accommodates D/A converters which are programmed parallely during the sweep and which provide control voltages. The voltage for the sweep output is applied to the rear panel where it provides a sawtooth voltage which starts at 0V at the sweep start and increases to 10 V at the end of sweep. The voltage for frequency-response correction is passed to a voltage-controlled amplifier on the IF filter board which compensates for the frequency-dependent attenuation characteristic of the input stages. The third tuning voltage leads to the RF module where the main coil of the YIG oscillator which is integrated in the YIG sampler is controlled by means of a voltage-controlled current source, thus controlling the coarse tuning of the first LO. D/A converters which are required for options are provided in the basic FSE model. A serial bus is available for the FTP to use when controlling time-critical settings.

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4.4 Selftest

The selftest allows for checking the instrument functions without using additional test instruments. When an instrument error occurs, the module which caused the error is indicated on the screen. The following measures are taken to localize an error:

- An additional A/D converter is provided which allows for measuring voltages on the various modules.
- While the selftest is being performed, important dc voltages, on-board supply voltages and amplifier operating points are measured and compared to their rated values.
- Level detectors check the oscillator levels required for operating the mixers
- The calibration generator generates a 120-MHz signal with a level of 0 dBm at the RF input of the instrument. The on-board level detectors in the signal path allow for processing of the input signal in the individual RF and IF stages.

4.4.1 Operation

Operation of the selftest is explained in Chapter 2, Section "Selftest Functions".

4.4.2 Testing the Processor Functions

The test of the processor functions comprises testing of the interface chips and the dynamic RAM, test of the graphic board and the connected transputers.
If the CPU, the dynamic RAM or the hard disk are defective, the instrument may not be able any more to output a detailed error message.

4.4.3 Testing the Synthesizers

Correct functioning of all oscillators is absolutely necessary for checking the signal path. Therefore, all synthesizer modules are checked next. The synthesizer modules are tested in the following order:

1. Test of the reference frequencies with 10 MHz and 120 MHz and the derived signals with 20, 30 and 60 MHz.
2. Measurement of the signals applied to the YIG sampler (output signal of fracsyn and output signal of sampler)
3. Test of the YIG main loop with the cutoff frequencies by measuring the YIG tuning voltage
4. Check of the LO levels and of the operating points of the LO drivers

In case of an error the selftest is aborted since it does not make sense measuring the signal path if e.g., no LO level is provided.

4.4.4 Testing the Signal Path

Subsequently, the modules in the signal path are checked. The fracsyn module accommodates a 120-MHz calibration generator, the output power of which is checked using individual test points. This signal is connected into the signal path via a changeover switch in the input attenuator of the FSE. The test sequence is as follows:

1. Check of the RF attenuator
2. Check of the RF converter by testing the operating points of the amplifiers
3. Check of the 2nd IF converter by testing the operating point of the amplifier for the second IF and reading out of the level detectors in the signal path.
4. Check of the IF filters by testing the supply voltages for the individual filter circuits, the tuning voltages for the filter bandwidths and the level detectors.
5. Check of detector board

Though the selftest provides high measuring depth, it cannot be assumed that the module which has been found out to be faulty is always really faulty. A faulty cable, e.g., has the same effect as an interrupt in the input attenuator. Therefore, have the faulty function checked by an R&S servicing shop when an error message occurs.

5 Checking the Rated Specifications

5.1 Measuring Equipment and Accessories

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
1	Frequency counter	error < $1x10^{-9}$, frequency range up to 10 MHz	Advantest R5361B with option 23		5.2.2
2	Signal generator	FSEA: 10 MHz to 3.5 GHz FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26.5 GHz FSEK: 10 MHz to 40 GHz	SMHU SMP02 SMP03 SMP04	0835.8011.52 1035.5005.02 1035.5005.03 1035.5005.04	5.2.3 5.2.4 5.2.5.1
3	Signal generator	phase noise at 498 MHz: < -100 dBc/Hz @ 100 Hz < -115 dBc/Hz @ 1 kHz < -127 dBc/Hz @ 10 kHz < -130 dBc/Hz @ 100 kHz < -142 dBc/Hz @ 1MHz	SMHU	0835.8011.52	5.2.1 5.2.5.1 5.2.5.2 5.2.6 5.2.8 to 12
4	Signal generator (FSEB / FSEM / FSEK)	FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26.5 GHz FSEK: 10 MHz to 40 GHz	SMP02 SMP03 SMP04	1035.5005.02 1035.5005.03 1035.5005.04	5.2.5.1 5.2.8
5	3-dB coupler (power combiner)	decoupling > 12 dB FSEA: 10 MHz to 3.5 GHz FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26.5 GHz FSEK: 10 MHz to 40 GHz			5.2.5.1
6	6-dB divider (power splitter)	level imbalance 1MHz to 1GHz ≤ 0.15 dB 1GHz to 7GHz ≤ 0.2 dB 7GHz to 18GHz ≤ 0.3 dB 18GHz to 26.5GHz ≤ 0.4 dB 26.5GHz to 40GHz ≤ 0.4 dB FSEA: 10 MHz to 3.5 GHz FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26,5 GHz FSEK: 10 MHz to 40 GHz			5.2.8
7	50-Ω termination	Return loss > 20 dB FSEA: up to 3.5 GHz FSEB: up to 7 GHz FSEM: up to 26.5 GHz FSEK: up to 40 GHz	 RNA RNA Wiltron 28S50 Wiltron 28K50	 0272.4510.50 0272.4510.50	5.2.7
8	Power meter		NRVD	0857.8008.02	5.2.1 5.2.3 5.2.8
9	Power sensor	1 MHz to 3.5 GHz RSS ≤ 0.8% Meter noise ≤ 20 pW	NRV-Z4	0828.3618.02	5.2.1 5.2.3 5.2.8

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
10	Power sensor (FSEB / FSEM / FSEK)	RSS referred to indicated Power: 1 MHz to 1 GHz ≤ 1.5 % 1 GHz to 7 GHz ≤ 2 % 7 GHz to 26.5 GHz ≤ 3.5 % 26.5 GHz to 40 GHz ≤ 4 % FSEB: 10 MHz to 7 GHz FSEM: 50 MHz to 26.5 GHz FSEK: 1 MHz to 40 GHz	 NRV-Z2 NRV-Z6 NRV-Z55	 0828.3218.02 0828.5010.02 1081.2005.02	5.2.3 5.2.8
11	Reflection coefficient VSWR bridge (FSEA / FSEB)	directivity > 30 dB FSEA / FSEB: 10 MHz to 3.5 GHz FSEB: 3.5 GHz to 7 GHz	 ZRC Wiltron 87A50 (also required: adapter 34AN50, open/short 22NF50)	1039.9492.55	5.2.3
12	Network analyzer (FSEM / FSEK)	FSEM: 10 MHz to 26,5 GHz FSEK: 10 MHz to 40 GHz			5.2.3
13	Step attenuator	variable attenuation 0 dB to 100 dB, 1-dB steps attenuation error < 0.05 dB (f = 5 MHz)	RSP	0831.3515.02	5.2.9 5.2.10 5.2.11
14	Attenuator (2 x)	fixed attenuation 10 dB FSEA: 10 MHz to 3.5 GHz FSEB: 10 MHz to 7 GHz FSEM: 10 MHz to 26.5 GHz FSEK: 10 MHz to 40 GHz	 DNF DNF Wiltron 43KB-10 Wiltron 43KC-10	 0272.4210.50 0272.4210.50	5.2.5.1
15	Lowpass	cut-off frequency: 10 kHz, 40 kHz, 100 kHz, 20 MHz, 29 MHz, 108 MHz, 263 MHz, 454 MHz, 641 MHz, 1.1 GHz, 1.3 GHz, 1.8 GHz			5.2.5.2
16	N-connecting cables Tracking RF input	Attenuation up to 7 GHz < 0.1dB			
17	2 DC sources for I and Q	can be set between ±0.5V	NGT35	0191.2019.02	
18	2 DC voltmeters		URE	0350.5315.02	

5.2 Test Instructions

The rated specifications of the analyzer are tested after a warm-up time of at least 30 minutes and overall calibration. Only in this case can the compliance with the guaranteed data be ensured.

Values given in the following sections are not guaranteed. Only the technical specifications of the data sheet are binding.

5.2.1 Checking the Calibration Source at 120 MHz

Note: *If option FSE-B22 is installed see chapter 5.4.1 for test instructions.*

Test equipment:

- signal generator (section 5.1, item 3):
  frequency 120 MHz
  level -40 dBm
- power meter (section 5.1, item 8)
- power sensor (section 5.1, item 9)
  frequency 120 MHz
  maximum power $P_{max} \geq 1$ µW
  meter noise ≤ 20 pW
  RSS ≤ 0.8% referred to indicated power
  impedance Z = 50 Ω

Power meter settings:

➢ connect power sensor to power meter and carry out function ´ZERO´ when no signal is applied to the power sensor.
➢ connect power sensor to RF output of signal generator.

Signal generator settings:

- frequency 120 MHz
- level –40 dBm ± 0.1 dB
  Use power meter for exact level adjustment.

Test setup:

➢ connect RF output of the signal generator to RF input of the FSE

FSE settings:

- [**SYSTEM PRESET**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**FREQUENCY SPAN** : **15 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **5 kHz**]
- [**LEVEL REF** : REF LEVEL : **-10 dBm**]
- [**INPUT** : RF ATTEN MANUAL : **20 dB**]

➢ set marker to peak of signal
[**MARKER SEARCH** : PEAK]

➢ set reference to peak of signal
[**MARKER DELTA** : REFERENCE FIXED]
➢ switch internal reference generator to RF input
[**CONFIGURATION SETUP** : SERVICE : INPUT CAL]
➢ set marker to peak of signal
[**MARKER SEARCH** : PEAK]

Evaluation:

The reading ´Delta 1 [T1 FXD]´ displays the difference between the output level of the signal generator and the level of the calibration source < 0.3 dB

Note:

The level of the calibration source can be adjusted with R22 on FracSyn module.

5.2.2 Checking the Frequency Accuracy of the Reference Oscillator

Test equipment:

frequency counter (section 5.1, item 1):
error < $1x10^{-9}$
frequency range up to 10 MHz

Test setup:

- connect frequency counter to 10-MHz reference output of the FSE (rear panel)

FSE settings:

- [**CONFIGURATION SETUP** : REFERENCE INT / EXT]
toggle to internal reference (INT)

Measurement:

measure frequency with frequency counter

nominal frequency:
Model 20 without OCXO (option B4) ..... 10 MHz ± 10 Hz
Model 30 or 20 with OCXO (option B4) ..... 10 MHz ± 1 Hz

5.2.3 Checking the Return Loss at the RF Input

Test equipment:

FSEA / FSEB:

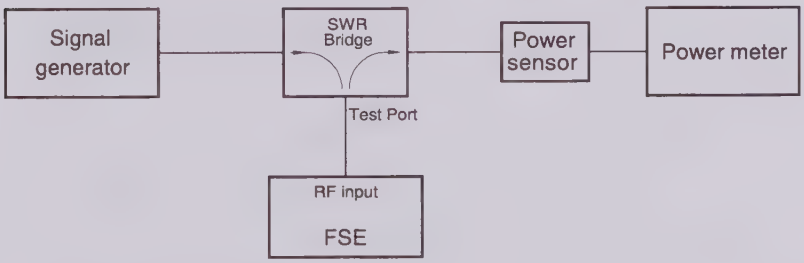
- signal generator (section 5.1, item 2)
  frequency range FSEA: 10 MHz to 3.5 GHz
  FSEB: 10 MHz to 7 GHz
  maximum level ≥ 0 dBm
- power meter (section 5.1, item 8)
- power sensor (section 5.1; FSEA: item 9; FSEB: item 10)
  frequency range FSEA: 10 MHz to 3.5 GHz
  FSEB: 10 MHz to 7 GHz
- reflection coefficient bridge (section 5.1, item 11)
  frequency range FSEA: 10 MHz to 3.5 GHz
  FSEB: 10 MHz to 7 GHz
  directivity ≥ 30 dB

FSEM / FSEK:

- network analyzer (section 5.1, item 12)
  frequency range FSEM: 10 MHz to 26.5 GHz
  FSEK: 10 MHz to 40 Ghz

Test setup:

FSEA / FSEB:



FSEM / FSEK:
Connect port 1 of network analyzer to RF input of the FSE.

Signal generator settings:
(FSEA / FSEB)

- level 0 dBm
- frequency $\{f_{in}\}$

See table 5-1 (item 3) of performance test report for values of f_{in}.

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]

Calibration:

FSEA / FSEB:
Use total reflection (OPEN or SHORT) at the test port of the SWR bridge as a reference:
Remove cable from RF input of the FSE and connect precision short or open to the cable. Determine reflected power with the power meter and store measured level L_{Ref} as reference. Repeat this procedure for every measurement over the whole frequency range.

FSEM / FSEK:
See operating manual of the network analyzer for detailed information about calibration for S_{11} measurement.

Measurement

FSEA / FSEB:
Connect the RF input of the FSE to the test port of the SWR bridge. Measure reflected power L_r with the power meter. The return loss a_r of the RF input of the FSE can be calculated as

$$a_r = L_{Ref} - L_r \, .$$

The SWR can be calculated as

$$s = \frac{10^{0.05a_r} + 1}{10^{0.05a_r} - 1} \, .$$

FSEM / FSEK:
Determine S_{11} of the FSE at the frequencies shown in table 5-1 (item 3) of performance test report. See operating manual of the network analyzer for detailed information about S_{11} measurement.

a_r / dB	s
6	3.0
7.4	2.5
8	2.3
9.5	2.0
10	1.9
12	1.7
14	1.5
16	1.4
18	1.3
20	1.2

5.2.4 Checking Imunity to Interference

Test equipment: signal generator (section 5.1, item 2):
frequency range FSEA: 10 MHz to 3.5 GHz
FSEB: 10 MHz to 7 GHz
FSEM / FSEK: 10 MHz to 8 GHz
maximum level ≥ -10 dBm

Test setup: connect RF output of the signal generator to RF input of the FSE.

Signal generator settings: level -10 dBm ± 0.5 dB

FSE settings:
- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **0 dB**]
- [**LEVEL REF** : REF LEVEL : **-30 dBm**]
- [**FREQUENCY SPAN** : **100 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **2 kHz**]

5.2.4.1 1st IF Image Frequency Rejection

Additional signal generator settings:
- frequency f_{in} + 2 x 1st IF

FSEA f_{in} + 8682.8 MHz
FSEB f_{in} + 15.8828 GHz
FSEM / FSEK f_{in} + 15.8828 GHz (f_{in} < 7 GHz)

See table 5-1 (item 4) of performance test report for values of f_{in}

Additional FSE settings:
- [**FREQUENCY CENTER** : {f_{in}}]

See table 5-1 (item 4) of performance test report for values of f_{in}

- set marker to peak of signal
[**MARKER SEARCH** : PEAK]

Evaluation: The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):

Image frequency rejection = -10dBm – L_{dis}

Unit	1st IF image frequency rejection
FSEA20	> 75 dB
FSEA30	> 80 dB
FSEB / FSEM / FSEK	> 80 dB

5.2.4.2 2nd IF Image Frequency Rejection

Additional signal generator settings:
- frequency f_{in} + 2 x 2nd IF
  f_{in} + 1482.8 MHz

See table 5-1 (item 5) of performance test report for values of f_{in}.

Additional FSE settings:
- [**FREQUENCY CENTER** : {f_{in}}]

See table 5-1 (item 5) of performance test report for values of f_{in}.

- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]

Evaluation:
The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):

Image frequency rejection = –10dBm – L_{dis}

Unit	2nd IF image frequency rejection
FSEA20	> 75 dB
FSEA30	> 80 dB
FSEB / FSEM / FSEK	> 80 dB

5.2.4.3 1st IF Rejection

Additional signal generator settings:
- frequency = 1st IF

FSEA	4341.4 MHz
FSEB	7941.4 GHz
FSEM / FSEK	7941.4 GHz (f_{in} < 7 GHz) 741.4 MHz (f_{in} ≥ 7 GHz)

Additional FSE settings:
- [**FREQUENCY CENTER** : {f_{in}}]

See table 5-1 (item 6) of performance test report for values of f_{in}.

- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]

Evaluation:
The IF rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):

IF rejection = –10dBm – L_{dis}

Unit	1st IF rejection
FSEA20	> 80 dB
FSEA30	> 100 dB
FSEB / FSEM	> 75 dB
FSEK	> 80 dB

5.2.5 Checking Non-linearities

5.2.5.1 Third-Order Intercept

Test equipment:

- 2 signal generators (FSEA: section 5.1, item 2 and 3;
  FSEB / M / K: section 5.1, item 2 and 4)
  frequency range
  FSEA: 10 MHz to 3.5 GHz
  FSEB: 10 MHz to 7 GHz
  FSEM: 10 MHz to 26.5 GHz
  FSEK: 10 MHz to 40 GHz
  maximum level ≥ 0 dBm
- 2 attenuators (section 5.1, item 14)
  attenuation a_{ATT} = 10 dB
  frequency range
  FSEA: 10 MHz to 3.5 GHz
  FSEB: 10 MHz to 7 GHz
  FSEM: 10 MHz to 26.5 GHz
  FSEK: 10 MHz to 40 GHz
- 3-dB coupler (section 5.1, item 5)
  frequency range
  FSEA: 10 MHz to 3.5 GHz
  FSEB: 10 MHz to 7 GHz
  FSEM: 10 MHz to 26.5 GHz
  FSEK: 10 MHz to 40 GHz
  decoupling > 12 dB

Test setup:

- connect RF outputs of the signal generators via 10-dB attenuators to the inputs of the 3-dB coupler
- connect output of the 3-dB coupler to RF input of the FSE.

Signal generator settings: (both generators)

- frequency: generator 1 $f_{g1} = f_{in}$
  generator 2 $f_{g2} = f_{in}$ + 100 kHz

  See table 5-1 (item 7) of performance test report for values of f_{in}
- level: 0 dBm

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **0 dB**]
- [**LEVEL REF** : **-10 dBm**]
- [**FREQUENCY SPAN** : **50 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **2 kHz**]
- [**FREQUENCY CENTER** : {f_{in}}]

  See table 5-1 (item 7) of performance test report for values of f_{in}
- [**MARKER SEARCH** : PEAK]

  Adjust the output level of signal generator 1 until the level reading of marker 1 is -10 dBm ± 0.1 dB.

- [**FREQUENCY CENTER** : {f_{in} + 100 kHz}]

  See table 5-1 (item 7) of performance test report for values of f_{in}

- [**MARKER SEARCH** : PEAK]

  Adjust the output level of signal generator 2 until the level reading of marker 1 is -10 dBm ± 0.1 dB.

- set reference to peak of signal
  [**MARKER DELTA** : REFERENCE FIXED]
- set center frequency to intermodulation product (2 x f_{g2} - f_{g1})
  [**FREQUENCY CENTER** : {f_{in} - 100 kHz}]

- [**MARKER SEARCH** : PEAK]

  The intermodulation ratio IMR_1 is displayed by the reading ´Delta 1 [T1 FXD]´

- set center frequency to intermodulation product (2 x f_{g1} - f_{g2})
  [**FREQUENCY CENTER** : {f_{in} + 200 kHz}]

- [**MARKER SEARCH** : PEAK]

  The intermodulation ratio IMR_2 is displayed by the reading ´Delta 1 [T1 FXD]´

Evaluation:

The third order intercept point (T.O.I) referred to the input signal can be caculated as

$$T.O.I. = \frac{IMR}{2} - 10dBm \ ,$$

where IMR is the lower of IMR_1 and IMR_2

Unit	Frequency range	T.O.I.
FSEA	f ≤ 50 MHz	≥ 7 dBm
	f > 50 MHz	≥ 12 dBm
FSEB / FSEM / FSEK	f ≤ 150 MHz	≥ 7 dBm
	f > 150 MHz	≥ 12 dBm
FSEK	f > 7 GHz	≥ 10 dBm

5.2.5.2 Second-Order Harmonic Distortion

Test equipment:

- signal generator (section 5.1, item 3)
  frequency range
  FSEA: 9 kHz to 1.7 GHz
  FSEB / FSEM / FSEK: 9 kHz to 3.4 GHz

- to improve the harmonic suppression of the generator it is recommended to insert a lowpass filter with a suitable cut-off frequency (section 5.1, item 15) after the generator.
  The harmonic suppression after the lowpass should be better than 65 dB to obtain an error lower than 1 dB over the whole frequency range.

Test setup:

- connect RF output of the signal generator to the input of the lowpass
- connect the output of the lowpass to the RF input of the FSE

Note: *If the harmonic suppression of the signal generator is sufficient, the lowpass can be left out.*
The RF output of the generator can be connected directly to the RF input of the FSE in this case.

Signal generator settings:

- frequency: f_{in}

see table 5-1 (item 8) of performance test report for values of f_{in}

- level: -10 dBm

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **0 dB**]
- [**LEVEL REF** : **-10 dBm**]
- [**FREQUENCY SPAN** : **3 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **1 kHz**]
- [**FREQUENCY CENTER** : {f_{in}}]

See table 5-1 (item 8) of performance test report for values of f_{in}

- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]
- set reference to peak of signal
  [**MARKER DELTA** : REFERENCE FIXED]
- set center frequency of the FSE to the frequency of the 2nd harmonic
  [**FREQUENCY CENTER** : {2 x f_{in}}]

See table 5-1 (item 8) of performance test report for values of f_{in}

- set marker to peak of the 2nd harmonic
  [**MARKER SEARCH** : PEAK]

Evaluation:

The reading ´Delta 1 [T1 FXD]´ displays the second harmonic suppression (a_{k2}). The exact input level L_{in} is displayed by the reading ´FXD {level} dBm´.
The second order harmonic distortion can be calculated as

$$IP_{k2} / dBm = a_{k2} + L_{in}$$

Unit	Frequency range	IP_{k2}
FSEA	f ≤ 50 MHz	> 25 dBm
	f > 50 MHz	> 45 dBm
FSEB / FSEM / FSEK	f ≤ 150 MHz	> 25 dBm
	f > 150 MHz	> 40 dBm

5.2.6 Checking IF Filters

Test equipment: signal generator (section 5.1, item 3):
frequency 120 MHz
level ≥ -10 dBm

Test setup: connect RF output of the signal generator to the RF input of the FSE.

5.2.6.1 Checking the Level Error

Note: *If option FSE-B22 is installed see chapter 5.4.2 for test instructions.*

Reference Measurement (RBW 5 kHz)

Signal generator settings:
- frequency: 120 MHz
- level: -20 dBm

FSE settings:
- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **0 dBm**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**SWEEP COUPLING** : COUPLING RATIO : RBW/VBW SINE [1]]
- [**SWEEP COUPLING** : COUPLING RATIO : SPAN/RBW MANUAL : **5** : **ENTER**]
- resolution bandwidth 5 kHz
  [**FREQUENCY SPAN** : **25 kHz**]
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]
- set reference to peak of signal
  [**MARKER DELTA** : REFERENCE FIXED]

Checking the Level Error

FSE settings:
- [**FREQUENCY SPAN** : {5 x RBW}]

  See table 5-1 (item 9) of performance test report for values of RBW.
- [**SWEEP COUPLING** : RES BW MANUAL : {RBW}][1]

  [1] ***Note:*** *To check the level error of the 5-MHz and the 10-MHz filter, the resolution bandwidth has to be set manually to 5 MHz or 10 MHz. All other bandwidths will be set automatically by changing the frequency span.*
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]

  The level error is displayed by the reading
  ´Delta 1 [T1 FXD] {level error} dB´.

Evaluation: See table 5-1 (item 9) of performance test report for upper and lower limits of level error.

5.2.6.2 Checking 3-dB Bandwidths

Signal generator settings:
- frequency: 120 MHz
- level: -20 dBm

FSE settings:
- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **0 dBm**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**SWEEP COUPLING** : COUPLING RATIO : RBW/VBW SINE [1]]
- [**SWEEP COUPLING** : COUPLING RATIO : SPAN/RBW MANUAL : **5** : **ENTER**]
- determine 3-dB bandwidth
  [**MARKER SEARCH** : **MENU** ⇒ : N DB DOWN : **3 dB**]
- [**FREQUENCY SPAN** : {5 x RBW}]
  See table 5-1 (item 10) of performance test report for values of RBW.
- [**SWEEP COUPLING** : RES BW MANUAL : {RBW}][1]

[1] ***Note:*** *To check the bandwidth of the 5-MHz and the 10-MHz filter, the resolution bandwidth has to be set manually to 5 MHz or 10 MHz. All other bandwidths will be set automatically by changing the frequency span.*

- [**MARKER SEARCH** : PEAK]

  The 3-dB bandwidth is displayed by the reading ´BW {bandwidth}´.

Evaluation:
See table 5-1 (item 10) of performance test report for upper and lower limits of 3dB-bandwidths.

5.2.6.3 Checking the Shape Factor

Signal generator settings:
- frequency: 120 MHz
- level: –10 dBm

FSE settings:
- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **0 dBm**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**SWEEP COUPLING** : VBW MANUAL : **100 Hz**]
- [**SWEEP COUPLING** : COUPLING RATIO : SPAN/RBW MANUAL : **30** : **ENTER**]
- determine shape factor
  [**MARKER SEARCH** : **MENU** ⇒ : SHAPE FACT 60/3 DB]
- [**FREQUENCY SPAN** : {30 x RBW}]

  See table 5-1 (item 11) of performance test report for values of RBW.
- [**SWEEP COUPLING** : RES BW MANUAL : {RBW}][1]

  [1] ***Note:*** *To check the shape factor of the 5-MHz and the 10-MHz filter the resolution bandwidth has to be set manually to 5 MHz or 10 MHz. All other bandwidths will be set automatically by changing the frequency span.*
- [**MARKER SEARCH** : PEAK]

  The shape factor is displayed by the reading ´SH3 {shape factor}´.

Evaluation:

See table 5-1 (item 11) of performance test report for upper and lower limits of shape factor.

5.2.7 Checking LO Feedthrough, Noise Display

Test equipment: 50-Ω termination (section 5.1, item 7)

frequency range	FSEA	up to 3.5 GHz
	FSEB	up to 7 GHz
	FSEM	up to 26.5 GHz
	FSEK	up to 40 GHz
return loss	> 20 dB	

Test setup: terminate the RF input of the FSE with 50 Ω

FSE settings:
- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **0 dB**]
- [**FREQUENCY SPAN** : **0 Hz**]

5.2.7.1 LO Feedthrough

Note: *This measurement is only possible with model 30. The LO feedthrough of model 20 can be checked by measuring the noise display near f = 0 Hz (see 5.3.7.2).*

Additional FSE settings:
- [**LEVEL REF** : **-10 dBm**]
- [**FREQUENCY CENTER** : **0 Hz**]
- start calibration of LO compensation
  [**SYSTEM CAL** : CAL LO SUP]
- set marker to peak
  [**MARKER SEARCH** : PEAK]

Evaluation: The LO feedthrough is displayed by the level reading of marker 1.

5.2.7.2 Noise Display

Additional FSE settings:
- [**SWEEP COUPLING** : RES BW MANUAL : **10 Hz**]
- [**SWEEP COUPLING** : VIDEO BW MANUAL : **1 Hz**]
- [**SWEEP COUPLING** : SWEEP TIME MANUAL : **0.1 s**]
- [**TRACE 1** : AVERAGE]
- [**TRACE 1** : SWEEP COUNT : **30 ENTER**]
- [**LEVEL REF** : **-60 dBm**]
- [**FREQUENCY CENTER** : {f_n}]

  See table 5-1 (item 13) of performance test report for values of f_n.
- set marker to peak
  [**MARKER SEARCH** : PEAK]

Evaluation: The noise level is displayed by the level reading of marker 1.

5.2.8 Checking the Frequency Response

Test equipment:

- signal generator (FSEA: section 5.1, item 3;
  FSEB / M / K: section 5.1, item 3 and item 4)
  frequency range FSEA: 1 MHz to 3.5 GHz
  FSEB: 1 MHz to 7 GHz
  FSEM: 1 MHz to 26.5 GHz
  FSEK: 1 MHz to 40 GHz
  maximum level ≥ -10 dBm
- power meter (section 5.1, item 8)
- power sensor (FSEA: section 5.1, item 9;
  FSEB / M: section 5.1, item 9 and 10;
  FSEK: section 5.1, item 10)
  frequency range FSEA: 1 MHz to 3.5 GHz
  FSEB: 1 MHz to 7 GHz
  FSEM: 1 MHz to 26.5 GHz
  FSEK: 1 MHz to 40 GHz
  maximum power $P_{max} \geq 100\ \mu W$
  RSS referred to indicated power 1 MHz to 1 GHz ..... ≤ 1.5 %
  1 GHz to 7 GHz ..... ≤ 2 %
  7 GHz to 26.5 GHz .... ≤ 3.5 %
  26.5 GHz to 40 GHz ..... ≤ 4 %
  impedance Z = 50 Ω
- 6-dB divider (section 5.1, item 6)
  frequency range FSEA: 1 MHz to 3.5 GHz
  FSEB: 1 MHz to 7 GHz
  FSEM: 1 MHz to 26.5 GHz
  FSEK: 1 MHz to 40 GHz
  level imbalance[1] 1 MHz to 1 GHz ≤ 0.15 dB
  1 GHz to 7 GHz ≤ 0.2 dB
  7 GHz to 18 GHz ≤ 0.3 dB
  18 GHz to 26.5 GHz ≤ 0.4 dB
  26.5 GHz to 40 GHz ≤ 0.4 dB

  [1]If a power splitter with higher level imbalance is used correction of the measured frequency response is recommended.

Determining the absolute error at 120 MHz

Test setup:

- connect power sensor (section 5.1, item 9) to the power meter and execute function ´ZERO´ when there is no signal applied to the power sensor
- connect power sensor to RF output of signal generator

Signal generator settings:

- frequency 120 MHz
- level -10 dBm

Measurement:

- determine output power of the signal generator with the power meter
- connect RF output of the signal generator to RF input of the FSE

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **-7 dBm**]
- [**FREQUENCY SPAN** : **15 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **5 kHz**]
- [**FREQUENCY CENTER** : **120 MHz**]
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]

Evaluation:

The deviation between the signal levels measured with the power meter and the FSE (level reading of marker 1) reflects the absolute level error of the FSE. It can be calculated as

$$\text{absolute error}_{120\text{MHz}} = L_{FSE} - L_{powermeter}$$

Checking the frequency response

Test setup:

- connect RF output of the signal generator to input of the divider
- connect output 1 of the divider to the power sensor of the power meter
- connect output 2 of the divider to RF input of the FSE

Signal generator settings:

- level -10 dBm
- frequency f_{fresp}

see table 5-1 (item 14) of performance test report for values of f_{fresp}

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **-7 dBm**]
- [**FREQUENCY SPAN** : **30 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **5 kHz**]
- [**FREQUENCY CENTER** : {f_{fresp}}]

see table 5-1 (item 14) of performance test report for values of f_{fresp}

- activate ´preselector peak´ if center frequency is higher than 7 GHz (only available for FSEM and FSEK)
  [**SYSTEM CAL** : PRESEL PEAK]
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]

The signal level L_{FSE} is displayed by the level reading of marker 1.

Power meter settings:

Determine signal level $L_{powermeter}$. To achive higher accuracy it is recommended to compensate the frequency response of the power sensor.

Evaluation:

The frequency response can be calculated as

$$\text{Frequency response} = L_{FSE} - L_{powermeter} - \text{absolute error}_{120\text{ MHz}}$$

Note: *If option FSE-B22 is installed see also chapter 5.4.3 for additional test instructions.*

5.2.9 Checking the Display Linearity

Note: *If option FSE-B22 is installed see chapter 5.4.4 for test instructions.*

Test equipment:

- signal generator (section 5.1, item 3)
  frequency 5 MHz
  maximum level ≥ 6 dBm
- step attenuator (section 5.1, item 13)
  frequency 5 MHz
  attenuation 0 to 95 dB
  steps 1 dB
  maximum attenuation error < 0.05 dB

Test setup:

- connect RF output of the signal generator to RF input of the step attenuator
- connect RF output of the step attenuator to RF input of the FSE

Signal generator settings:

- frequency 5 MHz
- level +6 dBm

Step attenuator settings: attenuation 16 dB

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **0 dBm**]
- [**FREQUENCY CENTER** : **5 MHz**]
- [**FREQUENCY SPAN** : **500 Hz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **3 kHz**]
- [**SWEEP COUPLING** : VIDEO BW MANUAL : **100 Hz**]
- [**LEVEL RANGE** : LOG 100 dB]
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]
- set reference to peak of signal
  [**MARKER DELTA** : REFERENCE FIXED]

Measurement

Step attenuator settings: attenuation $\{a_{ATT}\}$

see table 5-1 (item 15) of performance test report for values of a_{ATT}.

Evaluation: The difference between the level of the input signal of the FSE and the reference (about 10 dB below the reference level) is displayed by the reading ´Delta 1 [T1 FXD]´. Compare the measured values with the limits given in table 5-1 (item 15) of performance test report.

5.2.10 Checking the Attenuator

Note: *If option FSE-B22 is installed see chapter 5.4.5 for test instructions.*

Test equipment:

- signal generator (section 5.1, item 3)
  - frequency 5 MHz
  - maximum level ≥ 6 dBm
- step attenuator (section 5.1, item 13)
  - frequency 5 MHz
  - attenuation 0 to 70 dB
  - steps 10 dB
  - maximum attenuation error < 0.05 dB

Test setup:

- connect RF output of the signal generator to RF input of the step attenuator
- connect RF output of the step attenuator to RF input of the FSE

Signal generator settings:

- frequency 5 MHz
- level 0 dBm

Step attenuator settings:

attenuation 60 dB

FSE settings:

- [**SYSTEM PRESET**]
- [**FREQUENCY CENTER** : **5 MHz**]
- [**FREQUENCY SPAN** : **500 Hz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **3 kHz**]
- [**SWEEP COUPLING** : VIDEO BW MANUAL : **100 Hz**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **-30 dBm**]
- [**MARKER SEARCH** : PEAK]

adjust output level of the signal generator until the level reading of marker 1 is exactly -60.0 dBm.

Measurement

Step attenuator settings:

attenuation {a_{ATT}}

see table below for values of a_{ATT}.

FSE settings:

- [**INPUT** : RF ATTEN MANUAL : {a_{FSE}}]
- [**LEVEL REF** : {reference level} **dBm**]
- [**MARKER SEARCH** : PEAK]

see table below for values of a_{FSE} and reference level.

Evaluation:

Compare level reading of marker 1 with the limits given in table 5-1 (item 16) of performance test report.

a_{ATT}	70 dB	60 dB	50 dB	40 dB	30 dB	20 dB	10 dB	0 dB
a_{FSE}	0 dB	10 dB	20 dB	30 dB	40 dB	50 dB	60 dB	70 dB
reference level	-40 dBm	-30 dBm	-20 dBm	-10 dBm	0 dBm	+10 dBm	+20 dBm	+30 dBm

5.2.11 Checking the IF Gain Switching

Test principle:

The IF gain of the FSE can be switched from 0 to 50 dB by changing the reference level at fixed RF attenuation. To prevent the IF gain errors to be mixed up with the log amplifier error it is determined by comparison using an external precision attenuator.

Test equipment:

- signal generator (section 5.1, item 3)
  frequency 5 MHz
  maximum level ≥ -10 dBm
- step attenuator (section 5.1, item 11)
  frequency 5 MHz
  attenuation 0 to 50 dB
  steps 1 dB
  maximum attenuation error < 0.05 dB

Test setup:

- connect RF output of the signal generator to RF input of the step attenuator
- connect RF output of the step attenuator to RF input of the FSE

Signal generator settings:

- frequency 5 MHz
- level -10 dBm

Step attenuator settings:

attenuation 30 dB

FSE settings:

- [**SYSTEM PRESET**]
- [**FREQUENCY CENTER** : **5 MHz**]
- [**FREQUENCY SPAN** : **2 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **1 kHz**]
- [**SWEEP COUPLING** : VIDEO BW MANUAL : **100 Hz**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **-30 dBm**]
- [**MARKER SEARCH** : PEAK]

adjust output level of the signal generator until the level reading of marker 1 is exactly -40.0 dBm.

Measurement

Step attenuator settings:

attenuation {a_{ATT}}

see table below for values of a_{ATT}.

FSE settings:

- [**LEVEL REF** : {reference level} **dBm**]

  see table below for values of reference level.

- [**MARKER SEARCH** : PEAK]

Evaluation:

Compare level reading of marker 1 with the limits given in table 5-1 (item 17) of performance test report.

10-dB gain steps:

a_{ATT}	reference level	Marker level
0 dB	0 dBm	-10 ± 0.2 dBm
10 dB	-10 dBm	-20 ± 0.2 dBm
20 dB	-20 dBm	-30 ± 0.2 dBm
30 dB	-30 dBm	-40 ± 0.2 dBm
40 dB	-40 dBm	-50 ± 0.2 dBm
50 dB	-50 dBm	-60 ± 0.2 dBm

1-dB gain steps:

a_{ATT}	reference level	Marker level
30 dB	-30 dBm	-40.0 ± 0.2 dBm
31 dB	-31 dBm	-41 ± 0.2 dBm
32 dB	-32 dBm	-42 ± 0.2 dBm
33 dB	-33 dBm	-43 ± 0.2 dBm
34 dB	-34 dBm	-44 ± 0.2 dBm
35 dB	-35 dBm	-45 ± 0.2 dBm
36 dB	-36 dBm	-46 ± 0.2 dBm
37 dB	-37 dBm	-47 ± 0.2 dBm
38 dB	-38 dBm	-48 ± 0.2 dBm
39 dB	-39 dBm	-49 ± 0.2 dBm

5.2.12 Checking the Phase Noise

Test equipment:

signal generator (section 5.1, item 3)

frequency	498 MHz
level	≥ 0 dBm
phase noise at 498 Mhz:	< -100 dBc/Hz @ 100 Hz
	< -115 dBc/Hz @ 1 kHz
	< -127 dBc/Hz @ 10 kHz
	< -130 dBc/Hz @ 100 kHz
	< -142 dBc/Hz @ 1MHz

Test setup:

- connect RF output of the signal generator to RF input of the FSE
- connect signal generator EXT REF input to the EXT REF output of the FSE and set the generator to external reference

Signal generator settings:

- frequency 498 MHz
- level 0 dBm

FSE settings:

- [**SYSTEM PRESET**]
- [**CONFIGURATION SETUP** : REFERENCE INT / EXT]
  toggle to internal reference (INT)
- [**FREQUENCY CENTER** : **498 MHz**]
- [**REF LEVEL** : **0 dBm**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**FREQUENCY SPAN** : {span}]

  depending on offset, see table below for values of span.
- [**SWEEP COUPLING** : COUPLING RATIO : RBW/VBW NOISE]
- [**SWEEP COUPLING** : RBW MANUAL : {RBW}]

  depending on offset, see table below for values of RBW.
- [**TRACE 1** : AVERAGE]
- [**SWEEP** : SWEEP COUNT : **20** : **ENTER**]
- [**MARKER NORMAL**]
- set marker to peak of signal
  [**MARKER SEARCH**: PEAK]
- activate phase noise marker
  [**MARKER DELTA**: PHASE NOISE]
- [**FREQUENCY CENTER** : {498 MHz + offset}]

  see table below for values of offset.
- [**REF LEVEL** : {reference level}]

  depending on offset, see table below for values of reference level.
- [**INPUT** : RF ATTEN MANUAL : {a_{FSE}}]

  depending on offset, see table below for values of a_{FSE} .
- set phase noise marker
  [**MARKER DELTA** : {offset}]

  see table below for values of offset.

  ***Note**: Please make sure not to measure on a spurious signal.*

Evaluation: The phase noise is display by the reading ´Delta 1 [T1 NOI]´. Compare the measured values with the limits given in table 5-1 (item 18) of performance test report

Phase noise measurement settings				
Offset	**Span**	**RBW**	**Reference Level**	**a_{FSE}**
100 Hz	20 Hz	10 Hz	0 dBm	10 dB
1 kHz	200 Hz	100 Hz	0 dBm	10 dB
10 kHz	2 kHz	500 Hz	-10 dBm	10 dB
100 kHz	10 kHz	3 kHz	-20 dBm	0 dB
1 MHz	100 kHz	30 kHz	-20 dBm	0 dB

Notes: *To obtain a precise measurement of the phase noise at high offsets the level used at the FSE input is 20 dB higher than the reference level. To reduce the measurement time the phase noise is measured with a small span around the frequency offset. This prevents the FSE from being overloaded.*

5.2.13 Checking the Tracking Generator – Option FS-B8/B9/B10/B11

5.2.13.1 Checking the Output Level

Test equipment: N-connecting cable (Section 5.1, item no. 16)

Test setup: ➢ Connect output of tracking generator to RF-input of FSE.

FSE settings:
- [**MODE TRACKING**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**FREQUENCY SPAN** : **0 MHz**]
- [**SWEEP COUPLING** : RBW MANUAL : **20 kHz**]
- [**SWEEP COUPLING** : VBW MANUAL : **20 kHz**]
- [**LEVEL RANGE** : LOG 50 dB]
- [**MODE TRACKING** : SOURCE ON]
- [**MODE TRACKING** : SOURCE POWER {level}]

Values for {level} : 0 dBm; -3 dBm; -6 dBm; -10 dBm; -20 dBm

Test setup: ➢ Compare measured values with values from Table 5.3-1, item no. 19.

5.2.13.2 Checking the Frequency Response

Test equipment: N-connecting cable (Section 5.1, item no. 16)

Test setup: ➢ Connect output of tracking generator to RF-input of FSE.

FSE settings:
- [**MODE TRACKING**]
- [**FREQUENCY START** : **1 MHz**]
- [**FREQUENCY STOP** : **3.5(7) MHz**]
- [**SWEEP COUPLING** : RBW MANUAL : **20 kHz**]
- [**SWEEP COUPLING** : VBW MANUAL : **20 kHz**]
- [**SWEEP COUPLING** : SWEEP TIME MANUAL : **100 ms**]
- [**LEVEL RANGE** : LOG 50 dB]
- [**MODE TRACKING** : SOURCE ON]
- [**MODE TRACKING** : SOURCE POWER 0 dBm]

Evaluation: ➢ Compare measured values with limits from Table 5.3-1, item no. 20.

5.2.13.3 Checking the I/Q Modulator

Test equipment:
- 2 DC power sources (Section 5.1, item no. 17)
- 2 DC-voltmeters (Section 5.1, item no. 18)

Test setup:
- ➢ Connect DC power sources to the I and Q input of the analyzer.
- ➢ Use DC-voltmeter to measure voltage at the I and Q inputs.

Power source settings
- ➢ Set voltage to 250 mV ± 3 mV.

FSE settings:
- [**MODE TRACKING**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**FREQUENCY SPAN** : **0 MHz**]
- [**SWEEP COUPLING** : RBW MANUAL : **20 kHz**]
- [**SWEEP COUPLING** : VBW MANUAL : **20 kHz**]
- [**REF** : REF LEVEL : **0 dBm**]
- [**MODE TRACKING** : SOURCE POWER 0 dBm]
- [**MARKER NORMAL**]
- ➢ Rated value: -6 dBm ± 0.5 dB
  This value serves as a reference for the following measurements.

Measurements

Measurement of the residual carrier
- [**LEVEL RANGE** : 100 dB]
- ➢ Short-circuit I and Q voltages (do not remove!)
  The voltmeter must indicate a value < 0.1 mV.
- ➢ Rated value: < -50 dBm

Imbalance measurement (imbalance between the I and Q paths)
- [**LEVEL RANGE** : 10 dBm]
- ➢ Apply ±250 mV at the Q input, short-circuit at the I input.
- ➢ Rated value: (reference value – 3 dB) ±0.5 dB.
- ➢ Apply ±250 mV at the I input, short-circuit at the Q input.
- ➢ Rated value: (reference value - 3dB) ±0.5 dB.

Measurement of the quadrature offset
- ➢ Apply +250 mV at the I input, -250 mV at the Q input.
- ➢ Rated value: (reference value ±0.5 dB.
- ➢ Apply +250 mV at the Q input, -250 mV at the I input.
- ➢ Rated value: (reference value ± 0.5 dB.

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5.3 Performance Test Report

Note: *The values given in the datasheet are the guaranteed limits. Due to measurement errors these limits must be extended by the tolerance of the measuring equipment used in this performance test.*

Table 5.3-1 Performance test report

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
1	Calibration source at 120 MHz	5.2.1	-0.3	_____	+0.3	dB
2	Frequency accuracy Reference oscillator	5.2.2				
	Model 20		9.99999	_____	10.00001	MHz
	Model 30 or Model 20 with B4		9.999999	_____	10.000001	MHz
3	Return loss RF input f_{in}	5.2.3				
	FSEA / FSEB / FSEM / FSEK:					
	10 MHz		14	_____	-	dB
	250 MHz		14	_____	-	dB
	500 MHz		14	_____	-	dB
	750 MHz		14	_____	-	dB
	1000 MHz		14	_____	-	dB
	1250 MHz		14	_____	-	dB
	1500 MHz		14	_____	-	dB
	1750 MHz		14	_____	-	dB
	2000 MHz		14	_____	-	dB
	2250 MHz		14	_____	-	dB
	2500 MHz		14	_____	-	dB
	2750 MHz		14	_____	-	dB
	3000 MHz		14	_____	-	dB
	3250 MHz		14	_____	-	dB
	3500 MHz		14	_____	-	dB
	3250 MHz		14	_____	-	dB
	3500 MHz		14	_____	-	dB
	FSEB / FSEM / FSEK:					
	3750 MHz		9.5	_____	-	dB
	4000 MHz		9.5	_____	-	dB
	4250 MHz		9.5	_____	-	dB
	4500 MHz		9.5	_____	-	dB
	4750 MHz		9.5	_____	-	dB
	5000 MHz		9.5	_____	-	dB
	5250 MHz		9.5	_____	-	dB
	5500 MHz		9.5	_____	-	dB
	5750 MHz		9.5	_____	-	dB
	6000 MHz		9.5	_____	-	dB
	6250 MHz		9.5	_____	-	dB
	6500 MHz		9.5	_____	-	dB
	6750 MHz		9.5	_____	-	dB

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
3	Return loss RF input RF ATT: 10 dB	5.2.3				
	FSEM / FSEK:		**FSEM / K:**			
	7000 MHz		6 / 7.4	———	-	dB
	8000 MHz		6 / 7.4	———	-	dB
	9000 MHz		6 / 7.4	———	-	dB
	10 GHz		6 / 7.4	———	-	dB
	11 GHz		6 / 7.4	———	-	dB
	12 GHz		6 / 7.4	———	-	dB
	13 GHz		6 / 7.4	———	-	dB
	14 GHz		6 / 7.4	———	-	dB
	15 GHz		6 / 7.4	———	-	dB
	16 GHz		6 / 7.4	———	-	dB
	17 GHz		6 / 7.4	———	-	dB
	18 GHz		6 / 7.4	———	-	dB
	19 GHz		6 / 7.4	———	-	dB
	20 GHz		6 / 7.4	———	-	dB
	21 GHz		6 / 7.4	———	-	dB
	22 GHz		6 / 7.4	———	-	dB
	23 GHz		6 / 7.4	———	-	dB
	24 GHz		6 / 7.4	———	-	dB
	25 GHz		6 / 7.4	———	-	dB
	26 GHz		6 / 7.4	———	-	dB
	26.5 GHz		6 / 7.4	———	-	dB
	FSEK:					
	27 GHz		7.4	———	-	dB
	28 GHz		7.4	———	-	dB
	29 GHz		7.4	———	-	dB
	30 GHz		7.4	———	-	dB
	31 GHz		7.4	———	-	dB
	32 GHz		7.4	———	-	dB
	33 GHz		7.4	———	-	dB
	34 GHz		7.4	———	-	dB
	35 GHz		7.4	———	-	dB
	36 GHz		7.4	———	-	dB
	37 GHz		7.4	———	-	dB
	38 GHz		7.4	———	-	dB
	39 GHz		7.4	———	-	dB
	39.9 GHz		7.4	———	-	dB

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
4	1st IF image frequency rejection f_{in}	5.2.4.1				
	FSEA:		**Mod. 20 / 30**			
	11 MHz		75 / 80	_____	-	dB
	100 MHz		75 / 80	_____	-	dB
	1701 MHz		75 / 80	_____	-	dB
	3499 MHz		75 / 80	_____	-	dB
	FSEB / FSEM / FSEK:					
			80	_____	-	dB
	11 MHz		80	_____	-	dB
	100 MHz		80	_____	-	dB
	1701 MHz		80	_____	-	dB
	3499 MHz		80	_____	-	dB
	6999 MHz					
5	2nd IF image frequency rejection f_{in}	5.2.4.2				
	FSEA:		**Mod. 20 / 30**			
	999 MHz		75 / 80			
				_____	-	dB
	FSEB / FSEM / FSEK:					
	999 MHz		80	_____	-	dB
	7999 MHz		80	_____	-	dB
6	1st IF rejection f_{in}	5.2.4.3				
	FSEA:		**Mod. 20 / 30**			
	100 MHz		80 / 100	_____	-	dB
	1701 MHz		80 / 100	_____	-	dB
	3500 MHz		80 / 100	_____	-	dB
	FSEB / FSEM / FSEK:		**FSEB,M / K**			
	100 MHz		75 / 80	_____	-	dB
	1701 MHz		75 / 80	_____	-	dB
	3500 MHz		75 / 80	_____	-	dB
	FSEM / FSEK:		**FSEM / K**			
	7001 MHz		75 / 80	_____	-	dB

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
7	3rd-order intercept f_{in}	5.2.5.1				
	FSEA / FSEB / FSEM / FSEK:		**FSEA / B,M,K**			
	10 MHz		7 / 7	_____	-	dBm
	28 MHz		7 / 7	_____	-	dBm
	106 MHz		12 / 7	_____	-	dBm
	261 MHz		12 / 12	_____	-	dBm
	640 MHz		12 / 12	_____	-	dBm
	1 GHz		12 / 12	_____	-	dBm
	1.7 GHZ		12 / 12	_____	-	dBm
	2.5 GHz		12 / 12	_____	-	dBm
	3.48 GHz		12 / 12	_____	-	dBm
	FSEB / FSEM / FSEK:					
	6.98 GHz		12	_____	-	dBm
	FSEM / FSEK:		**FSEM / K**			
	7.5 GHz		12 / 10	_____	-	dBm
	15 GHz		12 / 10	_____	-	dBm
	25 GHz		12 / 10	_____	-	dBm
	FSEK:					
	30 GHz		10	_____	-	dBm
	35 GHz		10	_____	-	dBm
	39 GHz		10	_____	-	dBm
8	2nd-order harmonic distortion f_{in}	5.2.5.2				
	FSEA / FSEB / FSEM / FSEK:		**FSEA / B,M,K**			
	9 kHz		25 / 25	_____	-	dBm
	35 kHz		25 / 25	_____	-	dBm
	99 kHz		25 / 25	_____	-	dBm
	19 MHz		25 /25	_____	-	dBm
	28 MHz		25 / 25	_____	-	dBm
	107 MHz		45 / 25	_____	-	dBm
	262 MHz		45 / 40	_____	-	dBm
	453 MHz		45 / 40	_____	-	dBm
	640 MHz		45 / 40	_____	-	dBm
	1 GHz		45 / 40	_____	-	dBm
	1.25 GHz		45 / 40	_____	-	dBm
	1.7 GHz		45 / 40	_____	-	dBm
	FSEB / FSEM / FSEK:					
	3.4 GHz		40	_____	-	dBm

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
9	IF bandwidths Level error	5.2.6.1				
	reference (Ref): 5 kHz		-	_____	-	dBm
	100 Hz		-0.2	_____	+0.2	dB
	1 kHz		-0.2	_____	+0.2	dB
	2 kHz		-0.2	_____	+0.2	dB
	3 kHz		-0.2	_____	+0.2	dB
	10 kHz		-0.2	_____	+0.2	dB
	20 kHz		-0.2	_____	+0.2	dB
	30 kHz		-0.2	_____	+0.2	dB
	50 kHz		-1.0	_____	+1.0	dB
	100 kHz		-0.2	_____	+0.2	dB
	200 kHz		-0.2	_____	+0.2	dB
	300 kHz		-0.2	_____	+0.2	dB
	500 kHz		-0.2	_____	+0.2	dB
	1 MHz		-0.3	_____	+0.3	dB
	2 MHz		-0.3	_____	+0.3	dB
	3 MHz		-0.3	_____	+0.3	dB
	5 MHz		-0.3	_____	+0.3	dB
	10 MHz		-0.3	_____	+0.3	dB
10	IF bandwidths 3-dB bandwidth	5.2.6.2				
	100 Hz		-10 %-	_____	+10 %	-
	1 kHz		-10 %-	_____	+10 %	-
	2 kHz		-10 %-	_____	+10 %	-
	3 kHz		-10 %-	_____	+10 %	-
	5 kHz		-10 %-	_____	+10 %	-
	10 kHz		-10 %-	_____	+10 %	-
	20 kHz		-10 %-	_____	+10 %	-
	30 kHz		-10 %-	_____	+10 %	-
	50 kHz		-10 %-	_____	+10 %	-
	100 kHz		-10 %-	_____	+10 %	-
	200 kHz		-10 %-	_____	+10 %	-
	300 kHz		-10 %-	_____	+10 %	-
	500 kHz		-10 %-	_____	+10 %	-
	1 MHz		-10 %-	_____	+10 %	-
	2 MHz		-10 %-	_____	+10 %	-
	3 MHz		-10 %-	_____	+10 %	-
	5 MHz		-15 %-	_____	+15 %	-
	10 MHz		-10 %-	_____	+25 %	-

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
11	IF bandwidths Shape factor	5.2.6.2			**Mod. 20 / 30**	
	100 Hz		-	_____	6 / 6	-
	1 kHz		-	_____	15 / 12	-
	2 kHz		-	_____	15 / 12	-
	3 kHz		-	_____	15 / 12	-
	5 kHz		-	_____	15 / 12	-
	10 kHz		-	_____	15 / 12	-
	20 kHz		-	_____	15 / 12	-
	30 kHz		-	_____	15 / 12	-
	50 kHz		-	_____	15 / 12	-
	100 kHz		-	_____	15 / 12	-
	200 kHz		-	_____	15 / 12	-
	300 kHz		-	_____	15 / 12	-
	500 kHz		-	_____	15 / 12	-
	1 MHz		-	_____	15 / 12	-
	2 MHz		-	_____	15 / 12	-
	3 MHz		-	_____	7 / 7	-
	5 MHz		-	_____	7 / 7	-
	10 MHz		-	_____	7 / 7	-
12	LO feedthrough **(only model 30)**	5.2.7.1	-	_____	-20	dBm

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
13	Noise display f_n	5.2.7.2				
	FSEA:				Mod. 20 / 30	
	20 Hz		-	_____	- / -80	dBm
	1 kHz		-	_____	- / -110	dBm
	9.9 kHz		-	_____	-90 / -125	dBm
	95 kHz		-	_____	-110 / -135	dBm
	999 kHz		-	_____	-130 / -145	dBm
	9.99 MHz		-	_____	-145 / -145	dBm
	19.99 MHz		-	_____	-145 / -145	dBm
	49.99 MHz		-	_____	-145 / -145	dBm
	99.99 MHz		-	_____	-145 / -145	dBm
	199.99 MHz		-	_____	-145 / -145	dBm
	499.99 MHz		-	_____	-145 / -145	dBm
	999.9 MHz		-	_____	-145 / -145	dBm
	1999.9 MHz		-	_____	-145 / -145	dBm
	3499.9 MHz		-	_____	-145 / -145	dBm
	FSEB:				Mod. 20 / 30	
	20 Hz		-	_____	- / -74	dBm
	1 kHz		-	_____	- /-104	dBm
	9.9 kHz		-	_____	-84 / -119	dBm
	95 kHz		-	_____	-104 / -129	dBm
	999 kHz		-	_____	-125 / -142	dBm
	9.99 MHz		-	_____	-142 / -142	dBm
	19.99 MHz		-	_____	-142 / -142	dBm
	49.99 MHz		-	_____	-142 / -142	dBm
	99.99 MHz		-	_____	-142 / -142	dBm
	199.99 MHz		-	_____	-142 / -142	dBm
	499.99 MHz		-	_____	-142 / -142	dBm
	999.9 MHz		-	_____	-142 / -142	dBm
	1999.9 MHz		-	_____	-142 / -142	dBm
	3499.9 MHz		-	_____	-142 / -142	dBm
	5999.9 MHz		-	_____	-142 / -142	dBm
	6999.9 MHz		-	_____	-139 / -139	dBm

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
13	**FSEM:**	5.2.7.2			Mod. 20 / 30	
	20 Hz		-	_____	- / -74	dBm
	1 kHz		-	_____	- /-104	dBm
	9.9 kHz		-	_____	-84 / -119	dBm
	95 kHz		-	_____	-104 / -129	dBm
	999 kHz		-	_____	-124 / -142	dBm
	9.99 MHz		-	_____	-138 / -138	dBm
	19.99 MHz		-	_____	-138 / -138	dBm
	49.99 MHz		-	_____	-138 / -138	dBm
	99.99 MHz		-	_____	-138 / -138	dBm
	199.99 MHz		-	_____	-138 / -138	dBm
	499.99 MHz		-	_____	-138 / -138	dBm
	999.9 MHz		-	_____	-138 / -138	dBm
	1999.9 MHz		-	_____	-138 / -138	dBm
	3499.9 MHz		-	_____	-138 / -138	dBm
	5999.9 MHz		-	_____	-138 / -138	dBm
	6999.9 MHz		-	_____	-135 / -135	dBm
	7199.9 MHz		-	_____	-138 / -138	dBm
	11999.9 MHz		-	_____	-138 / -138	dBm
	17999.9 MHz		-	_____	-138 / -138	dBm
	21999.9 MHz		-	_____	-135 / -135	dBm
	26399.9 MHz		-	_____	-135 / -135	dBm
	FSEK:				Mod. 20 / 30	
	20 Hz		-	_____	- / -74	dBm
	1 kHz		-	_____	- /-104	dBm
	9.9 kHz		-	_____	-84 / -119	dBm
	95 kHz		-	_____	-104 / -129	dBm
	999 kHz		-	_____	-124 / -142	dBm
	9.99 MHz		-	_____	-138 / -138	dBm
	19.99 MHz		-	_____	-138 / -138	dBm
	49.99 MHz		-	_____	-138 / -138	dBm
	99.99 MHz		-	_____	-138 / -138	dBm
	199.99 MHz		-	_____	-138 / -138	dBm
	499.99 MHz		-	_____	-138 / -138	dBm
	999.9 MHz		-	_____	-138 / -138	dBm
	1999.9 MHz		-	_____	-138 / -138	dBm
	3499.9 MHz		-	_____	-138 / -138	dBm
	5999.9 MHz		-	_____	-138 / -138	dBm
	6999.9 MHz		-	_____	-135 / -135	dBm
	7199.9 MHz		-	_____	-134 / -134	dBm
	11999.9 MHz		-	_____	-134 / -134	dBm
	17999.9 MHz		-	_____	-134 / -134	dBm
	21999.9 MHz		-	_____	-131 / -131	dBm
	26499.9 MHz		-	_____	-131 / -131	dBm
	27000 MHz		-	_____	-120 / -120	dBm
	29999 MHz		-	_____	-120 / -120	dBm
	30000 MHz		-	_____	-116 / -116	dBm
	35000 MHz		-	_____	-116 / -116	dBm
	40000 MHz		-	_____	-116 / -116	dBm

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
14	Frequency response	5.2.8				
	FSEA / FSEB / FSEM / FSEK:					
	120 MHz (absolute error)		-0.3	_____	+0.3	dB
	f_{fresp}					
	1 MHz		-0.5	_____	+0.5	dB
	10 MHz		-0.5	_____	+0.5	dB
	50 MHz		-0.5	_____	+0.5	dB
	100 MHz		-0.5	_____	+0.5	dB
	200 MHz		-0.5	_____	+0.5	dB
	300 MHz		-0.5	_____	+0.5	dB
	400 MHz		-0.5	_____	+0.5	dB
	500 MHz		-0.5	_____	+0.5	dB
	600 MHz		-0.5	_____	+0.5	dB
	700 MHz		-0.5	_____	+0.5	dB
	800 MHz		-0.5	_____	+0.5	dB
	900 MHz		-0.5	_____	+0.5	dB
	1000 MHz		-0.5	_____	+0.5	dB
	1500 MHz		-1	_____	+1	dB
	2000 MHz		-1	_____	+1	dB
	2500 MHz		-1	_____	+1	dB
	3000 MHz		-1	_____	+1	dB
	3499 MHz		-1	_____	+1	dB
	FSEB / FSEM / FSEK:					
	4000 MHz		-1	_____	+1	dB
	4500 MHz		-1	_____	+1	dB
	5000 MHz		-1	_____	+1	dB
	5500 MHz		-1	_____	+1	dB
	6000 MHz		-1	_____	+1	dB
	6500 MHz		-1	_____	+1	dB
	6999 MHz		-1	_____	+1	dB

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
14	**FSEM / FSEK:**	5.2.8				
	8000 MHz		-2	_____	+2	dB
	9000 MHz		-2	_____	+2	dB
	10000 MHz		-2	_____	+2	dB
	11000 MHz		-2	_____	+2	dB
	12000 MHz		-2	_____	+2	dB
	13000 MHz		-2	_____	+2	dB
	14000 MHz		-2	_____	+2	dB
	15000 MHz		-2	_____	+2	dB
	16000 MHz		-2	_____	+2	dB
	17000 MHz		-2	_____	+2	dB
	18000 MHz		-2	_____	+2	dB
	19000 MHz		-2.5	_____	+2.5	dB
	20000 MHz		-2.5	_____	+2.5	dB
	21000 MHz		-2.5	_____	+2.5	dB
	22000 MHz		-2.5	_____	+2.5	dB
	23000 MHz		-2.5	_____	+2.5	dB
	24000 MHz		-2.5	_____	+2.5	dB
	25000 MHz		-2.5	_____	+2.5	dB
	26000 MHz		-2.5	_____	+2.5	dB
	26499 MHz		-2.5	_____	+2.5	dB
	FSEK:					
	27000 MHz		-3	_____	+3	dB
	28000 MHz		-3	_____	+3	dB
	29000 MHz		-3	_____	+3	dB
	30000 MHz		-3	_____	+3	dB
	31000 MHz		-3	_____	+3	dB
	32000 MHz		-3	_____	+3	dB
	33000 MHz		-3	_____	+3	dB
	34000 MHz		-3	_____	+3	dB
	35000 MHz		-3	_____	+3	dB
	36000 MHz		-3	_____	+3	dB
	37000 MHz		-3	_____	+3	dB
	38000 MHz		-3	_____	+3	dB
	39000 MHz		-3	_____	+3	dB
	40000 MHz		-3	_____	+3	dB

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
15	Display linearity	5.2.9				
	a_{ATT}					
	6 dB		9.7	_____	10.3	dB
	8 dB		7.7	_____	8.3	dB
	10 dB		5.7	_____	6.3	dB
	12 dB		3.7	_____	4.3	dB
	14 dB		1.7	_____	2.3	dB
	16 dB		-	Reference	-	-
	18 dB		-2.3	_____	-1.7	dB
	20 dB		-4.3	_____	-3.7	dB
	22 dB		-6.3	_____	-5.7	dB
	24 dB		-8.3	_____	-7.7	dB
	26 dB		-10.3	_____	-9.7	dB
	28 dB		-12.3	_____	-11.7	dB
	30 dB		-14.3	_____	-13.7	dB
	32 dB		-16.3	_____	-15.7	dB
	34 dB		-18.3	_____	-17.7	dB
	36 dB		-20.3	_____	-19.7	dB
	38 dB		-22.3	_____	-21.7	dB
	40 dB		-24.3	_____	-23.7	dB
	42 dB		-26.3	_____	-25.7	dB
	44 dB		-28.3	_____	-27.7	dB
	46 dB		-30.3	_____	-29.7	dB
	48 dB		-32.3	_____	-31.7	dB
	50 dB		-34.3	_____	-33.7	dB
	52 dB		-36.3	_____	-35.7	dB
	54 dB		-38.3	_____	-37.7	dB
	56 dB		-40.3	_____	-39.7	dB
	61 dB		-45.5	_____	-44.5	dB
	66 dB		-50.5	_____	-49.5	dB
	71 dB		-55.5	_____	-54.5	dB
	76 dB		-60.5	_____	-59.5	dB
	81 dB		-66.0	_____	-64.0	dB
	86 dB		-71.0	_____	-69.0	dB
	only models 30					
	91 dB		-76.0	_____	-74.0	dB
	96 dB		-81.0	_____	-79.0	dB
	101 dB		-86.0	_____	-84.0	dB
16	Attenuator	5.2.10				
	a_{ATT}					
	70		-70.3	_____	-69.7	dBm
	60		-60.3	_____	-59.7	dBm
	50		-50.3	_____	-49.7	dBm
	40		-40.3	_____	-39.7	dBm
	30		-30.3	_____	-29.7	dBm
	20		-20.3	_____	-19.7	dBm
	10		-10.3	_____	-9.7	dBm
	0		-0.3	_____	+0.3	dBm

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
17	IF gain switching	5.2.11				
	Reference level					
	0 dBm		-10.2	_____	-9.8	dBm
	-10 dBm		-20.2	_____	-19.8	dBm
	-20 dBm		-30.2	_____	-29.8	dBm
	-30 dBm		-40.2	_____	-39.8	dBm
	-40 dBm		-50.2	_____	-49.8	dBm
	-50 dBm		-60.2	_____	-59.8	dBm
	-31 dBm		-41.2	_____	-40.8	dBm
	-32 dBm		-42.2	_____	-41.8	dBm
	-33 dBm		-43.2	_____	-42.8	dBm
	-34 dBm		-44.2	_____	-43.8	dBm
	-35 dBm		-45.2	_____	-44.8	dBm
	-36 dBm		-46.2	_____	-45.8	dBm
	-37 dBm		-47.2	_____	-46.8	dBm
	-38 dBm		-48.2	_____	-47.8	dBm
	-39 dBm		-49.2	_____	-48.8	dBm
18	Phase noise offset:	5.2.12				
	FSEA20:					
	1 kHz		-	_____	-85	dBc/Hz
	10 kHz		-	_____	-95	dBc/Hz
	100 kHz		-	_____	-119	dBc/Hz
	1 MHz		-	_____	-135	dBc/Hz
	FSEA30:					
	100 Hz		-	_____	-87	dBc/Hz
	1 kHz		-	_____	-107	dBc/Hz
	10 kHz		-	_____	-120	dBc/Hz
	100 kHz		-	_____	-117	dBc/Hz
	1 MHz		-	_____	-135	dBc/Hz
	FSEB/M/K 20:					
	1 kHz		-	_____	-79	dBc/Hz
	10 kHz		-	_____	-90	dBc/Hz
	100 kHz		-	_____	-113	dBc/Hz
	1 MHz		-	_____	-129	dBc/Hz
	FSEB/M/K 30:					
	100 Hz		-	_____	-81	dBc/Hz
	1 kHz		-	_____	-100	dBc/Hz
	10 kHz		-	_____	-114	dBc/Hz
	100 kHz		-	_____	-111	dBc/Hz
	1 MHz		-	_____	-129	dBc/Hz
19	option tracking generator	5.2.13				
	output level					
	0 dBm		-0.1	_____	0.1	dBm
	–3 dBm		-3.1	_____	-2.9	dBm
	–6 dBm		-6.1	_____	-5.9	dBm
	–10 dBm		-10.1	_____	-9.9	dBm
	–20 dBm		-20.2	_____	-19.8	dBm

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
20	option tracking generator frequency response 1 MHz to 1 GHz 1 GHz to 3.5 GHz 3.5 GHz to 7 GHz	5.2.13	 -2 -3 -3	 _____ _____ _____	 2 3 3 (typ)	 dBm dBm dBm
21	option tracking generator I/Q-modulator residual carrier imbalance quadrature offset	5.2.13	 - -10 - 7	 _____ _____ _____	 -50 -8 -5	 dBm dBm dBm

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5.4 Test Instructions (option FSE-B22 included)

The rated specifications of the analyzer are tested after a warm-up time of at least 30 minutes and overall calibration. Only in this case can the compliance with the guaranteed data be ensured.

Values given in the following sections are not guaranteed. Only the technical specifications of the data sheet are binding.

Additional equipment required for performance test (option FSE-B22 included)

Item	Type of equipment	Specifications recommended	Recommended equipment	R&S Order No.	Use
1	Power sensor	frequency 1 MHz to 2 GHz RSS referred to indicated power ≤ 0.8 %	NRV-Z51	0857.9004.02	5.3.3
2	6-dB divider (power splitter)	frequency 1 MHz to 2 GHz level imbalance ≤ 0.1 dB	RVZ	0800.6612.52	5.3.3

5.4.1 Checking the Calibration Source at 120 MHz

Test equipment:

- signal generator (section 5.1, item 3):
  frequency 120 MHz
  level -40 dBm
- power meter (section 5.1, item 8)
- power sensor (section 5.1, item 9)
  frequency 120 MHz
  maximum power $P_{max} \geq 1$ µW
  meter noise ≤ 20 pW
  RSS ≤ 0.8% referred to indicated power
  impedance Z = 50 Ω

Power meter settings:

- connect power sensor to power meter and carry out function ´ZERO´ when no signal is applied to the power sensor.
- connect power sensor to RF output of signal generator.

Signal generator settings:

- frequency 120 MHz
- level -40 dBm ± 0.1 dB
  Use power meter for exact level adjustment.

Test setup:

connect RF output of the signal generator to RF input of the FSE

FSE settings:

- [**SYSTEM PRESET**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**FREQUENCY SPAN** : **15 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **5 kHz**]
- [**LEVEL REF** : REF LEVEL : **-10 dBm**]
- [**INPUT** : RF ATTEN MANUAL : **20 dB**]

- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]
- set reference to peak of signal
  [**MARKER DELTA** : REFERENCE FIXED]
- switch internal reference generator to RF input
  [**CONFIGURATION SETUP** : SERVICE : INPUT CAL]
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]

Evaluation: The reading ´Delta 1 [T1 FXD]´ displays the difference between the output level of the signal generator and the level of the calibration source ..... < 0.2 dB

Note: *The level of the calibration source can be adjusted with R22 on FracSyn module.*

5.4.2 Checking IF Filters

Test equipment: signal generator (section 5.1, item 3):
frequency 120 MHz
level ≥ -10 dBm

Test setup: connect RF output of the signal generator to the RF input of the FSE.

5.4.2.1 Checking the Level Error

Reference Measurement (RBW 5 kHz)

Signal generator settings:
- frequency: 120 MHz
- level: -20 dBm

FSE settings:
- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **0 dBm**]
- [**FREQUENCY CENTER** : **120 MHz**]
- [**SWEEP COUPLING** : COUPLING RATIO : RBW/VBW SINE [1]]
- [**SWEEP COUPLING** : COUPLING RATIO : SPAN/RBW MANUAL : **5** : **ENTER**]
- resolution bandwidth 5 kHz
  [**FREQUENCY SPAN** : **25 kHz**]
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]
- set reference to peak of signal
  [**MARKER DELTA** : REFERENCE FIXED]

Checking the Level Error

FSE settings:

- [**FREQUENCY SPAN** : {5 x RBW}]

  See table 5-2 (item 2) of performance test report for values of RBW.

- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]

  The level error is displayed by the reading
  'Delta 1 [T1 FXD] {level error} dB'.

Evaluation:

See table 5-2 (item 2) of performance test report for upper and lower limits of level error.

5.4.3 Checking the Frequency Response

Test equipment:

- signal generator (section 5.1, item 3)
  frequency range 1 MHz to 2 GHz
  maximum level ≥ -10 dBm
- power meter (section 5.1, item 8)
- power sensor (section 5.3, item 1)
  frequency range 1 MHz to 2 GHz
  maximum power $P_{max} \geq 100$ µW
  RSS referred to indicated power ≤ 0.8 %
  impedance Z = 50 Ω
- 6-dB divider (section 5.3, item 2)
  frequency range 1 MHz to 2 GHz
  level imbalance[1] ≤ 0.1 dB

  [1]If a power splitter with higher level imbalance is used correction of the measured frequency response is recommended.

Determining the absolute error at 120 MHz

Test setup:

- connect power sensor (section 5.3, item 1) to the power meter and execute function 'ZERO' when there is no signal applied to the power sensor
- connect power sensor to RF output of signal generator

Signal generator settings:

- frequency 120 MHz
- level -10 dBm

Measurement:

- determine output power of the signal generator with the power meter
- connect RF output of the signal generator to RF input of the FSE

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : {a_{FSE}} **dB**]
  See
- [**LEVEL REF** : **-7 dBm**]
- [**FREQUENCY SPAN** : **15 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **5 kHz**]
- [**FREQUENCY CENTER** : **120 MHz**]
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]

Evaluation:

The deviation between the signal levels measured with the power meter and the FSE (level reading of marker 1) reflects the absolute level error of the FSE. It can be calculated as

$$\text{absolute error}_{120MHz} = L_{FSE} - L_{powermeter}$$

Checking the frequency response

Test setup:

- connect RF output of the signal generator to input of the divider
- connect output 1 of the divider to the power sensor of the power meter
- connect output 2 of the divider to RF input of the FSE

Signal generator settings:

- level -10 dBm
- frequency f_{fresp}

see table 5-2 (item 3) of performance test report for values of f_{fresp}

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **-7 dBm**]
- [**FREQUENCY SPAN** : **30 kHz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **5 kHz**]
- [**FREQUENCY CENTER** : {f_{fresp}}]

see table 5-2 (item 3) of performance test report for values of f_{fresp}

- activate ´preselector peak´ if center frequency is higher than 7 GHz (only available for FSEM and FSEK)
  [**SYSTEM CAL** : PRESEL PEAK]
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]

the signal level L_{FSE} is displayed by the level reading of marker 1.

Power meter settings:

Determine signal level $L_{powermeter}$. To achive higher accuracy it is recommended to compensate the frequency response of the power sensor.

Evaluation:

The frequency response can be calculated as

$$\text{Frequency response} = L_{FSE} - L_{powermeter} - \text{absolute error}_{120\ MHz}$$

5.4.4 Checking the Display Linearity

Test equipment:

- signal generator (section 5.1, item 3)
  frequency 5 MHz
  maximum level ≥ 6 dBm
- step attenuator (section 5.1, item 13)
  frequency 5 MHz
  attenuation 0 to 95 dB
  steps 1 dB
  maximum attenuation error < 0.01 dB

Test setup:

- connect RF output of the signal generator to RF input of the step attenuator
- connect RF output of the step attenuator to RF input of the FSE

Signal generator settings:

- frequency 5 MHz
- level +6 dBm

Step attenuator settings:

attenuation 16 dB

FSE settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **0 dBm**]
- [**FREQUENCY CENTER** : **5 MHz**]
- [**FREQUENCY SPAN** : **500 Hz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **3 kHz**]
- [**SWEEP COUPLING** : VIDEO BW MANUAL : **100 Hz**]
- [**LEVEL RANGE** : LOG 100 dB]
- set marker to peak of signal
  [**MARKER SEARCH** : PEAK]
- set reference to peak of signal
  [**MARKER DELTA** : REFERENCE FIXED]

Measurement

Step attenuator settings:

attenuation {a_{ATT}}

See table 5-2 (item 4) of performance test report for values of a_{ATT}.

Evaluation:

The difference between the level of the input signal of the FSE and the reference (about 10 dB below the reference level) is displayed by the reading ´Delta 1 [T1 FXD]´. Compare the measured values with the limits given in table 5-2 (item 4) of performance test report.

5.4.5 Checking the Attenuator

Test equipment:

- signal generator (section 5.1, item 3)
  frequency 5 MHz
  maximum level ≥ 6 dBm
- step attenuator (section 5.1, item 13)
  frequency 5 MHz
  attenuation 0 to 70 dB
  steps 10 dB
  maximum attenuation error < 0.05 dB

Test setup:

- connect RF output of the signal generator to RF input the step attenuator
- connect RF output of the step attenuator to RF input of the FSE

Signal generator settings:

- frequency 5 MHz
- level 0 dBm

Step attenuator settings:

attenuation 60 dB

FSE settings:

- [**SYSTEM PRESET**]
- [**FREQUENCY CENTER** : **5 MHz**]
- [**FREQUENCY SPAN** : **500 Hz**]
- [**SWEEP COUPLING** : RES BW MANUAL : **3 kHz**]
- [**SWEEP COUPLING** : VIDEO BW MANUAL : **100 Hz**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]
- [**LEVEL REF** : **-30 dBm**]
- [**MARKER SEARCH** : PEAK]

adjust output level of the signal generator until the level reading of marker 1 is exactly -60.0 dBm.

Measurement

Step attenuator settings:

attenuation {a_{ATT}}

See table below for values of a_{ATT}.

FSE settings:

- [**INPUT** : RF ATTEN MANUAL : {a_{FSE}}]
- [**LEVEL REF** : {reference level} **dBm**]
- [**MARKER SEARCH** : PEAK]

see table below for values of a_{FSE} and reference level.

Evaluation:

Compare level reading of marker 1 with the limits given in table 5-2 (item 5) of performance test report.

a_{ATT}	40 dB	30 dB	20 dB	10 dB
a_{FSE}	30 dB	40 dB	50 dB	60 dB
reference level	-10 dBm	0 dBm	+10 dBm	+20 dBm

5.5 Performance Test Report (option FSE-B22 included)

Note: *The values given in the datasheet are the guaranteed limits. Due to measurement errors these limits must be extended by the tolerance of the measuring equipment used in this performance test.*

Table 5.5-1 Performance test report

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
1	Calibration source at 120 MHz	5.3.1	-0.2	_____	+0.2	dB
2	IF bandwidths Level error	5.3.2.1				
	reference (Ref): 5 kHz		-	_____	-	dBm
	100 Hz		-0.15	_____	+0.15	dB
	1 kHz		-0.15	_____	+0.15	dB
	2 kHz		-0.15	_____	+0.15	dB
	3 kHz		-0.15	_____	+0.15	dB
	5 kHz		-0.15	_____	+0.15	dB
	10 kHz		-0.15	_____	+0.15	dB
	20 kHz		-0.15	_____	+0.15	dB
	30 kHz		-0.15	_____	+0.15	dB
	300 kHz		-0.15	_____	+0.15	dB
3	Frequency response	5.3.3				
	RF-Attenuation a_{FSE} = 10 dB 120 MHz (absolute error)		-0.2	_____	+0.2	dB
	f_{fresp}					
	1 MHz		-0.3	_____	+0.3	dB
	10 MHz		-0.3	_____	+0.3	dB
	50 MHz		-0.3	_____	+0.3	dB
	100 MHz		-0.3	_____	+0.3	dB
	200 MHz		-0.3	_____	+0.3	dB
	300 MHz		-0.3	_____	+0.3	dB
	400 MHz		-0.3	_____	+0.3	dB
	500 MHz		-0.3	_____	+0.3	dB
	600 MHz		-0.3	_____	+0.3	dB
	700 MHz		-0.3	_____	+0.3	dB
	800 MHz		-0.3	_____	+0.3	dB
	900 MHz		-0.3	_____	+0.3	dB
	1000 MHz		-0.3	_____	+0.3	dB
	1100 MHz		-0.3	_____	+0.3	dB
	1200 MHz		-0.3	_____	+0.3	dB
	1300 MHz		-0.3	_____	+0.3	dB
	1400 MHz		-0.3	_____	+0.3	dB
	1500 MHz		-0.3	_____	+0.3	dB
	1600 MHz		-0.3	_____	+0.3	dB
	1700 MHz		-0.3	_____	+0.3	dB
	1800 MHz		-0.3	_____	+0.3	dB
	1900 MHz		-0.3	_____	+0.3	dB
	2000 MHz		-0.3	_____	+0.3	dB

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
3	Frequency response	5.3.3				
	RF-Attenuation					
	a_{FSE} = 20 dB					
	120 MHz		-0.2	_____	+0.2	dB
	(absolute error)					
	f_{fresp}					
	1 MHz		-0.45	_____	+0.45	dB
	10 MHz		-0.45	_____	+0.45	dB
	50 MHz		-0.45	_____	+0.45	dB
	100 MHz		-0.45	_____	+0.45	dB
	200 MHz		-0.45	_____	+0.45	dB
	300 MHz		-0.45	_____	+0.45	dB
	400 MHz		-0.45	_____	+0.45	dB
	500 MHz		-0.45	_____	+0.45	dB
	600 MHz		-0.45	_____	+0.45	dB
	700 MHz		-0.45	_____	+0.45	dB
	800 MHz		-0.45	_____	+0.45	dB
	900 MHz		-0.45	_____	+0.45	dB
	1000 MHz		-0.45	_____	+0.45	dB
	1100 MHz		-0.45	_____	+0.45	dB
	1200 MHz		-0.45	_____	+0.45	dB
	1300 MHz		-0.45	_____	+0.45	dB
	1400 MHz		-0.45	_____	+0.45	dB
	1500 MHz		-0.45	_____	+0.45	dB
	1600 MHz		-0.45	_____	+0.45	dB
	1700 MHz		-0.45	_____	+0.45	dB
	1800 MHz		-0.45	_____	+0.45	dB
	1900 MHz		-0.45	_____	+0.45	dB
	2000 MHz		-0.45	_____	+0.45	dB

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
3	Frequency response	5.3.3				
	RF-Attenuation					
	a_{FSE} = 30 dB					
	120 MHz		-0.2	_____	+0.2	dB
	(absolute error)					
	f_{fresp}					
	1 MHz		-0.45	_____	+0.45	dB
	10 MHz		-0.45	_____	+0.45	dB
	50 MHz		-0.45	_____	+0.45	dB
	100 MHz		-0.45	_____	+0.45	dB
	200 MHz		-0.45	_____	+0.45	dB
	300 MHz		-0.45	_____	+0.45	dB
	400 MHz		-0.45	_____	+0.45	dB
	500 MHz		-0.45	_____	+0.45	dB
	600 MHz		-0.45	_____	+0.45	dB
	700 MHz		-0.45	_____	+0.45	dB
	800 MHz		-0.45	_____	+0.45	dB
	900 MHz		-0.45	_____	+0.45	dB
	1000 MHz		-0.45	_____	+0.45	dB
	1100 MHz		-0.45	_____	+0.45	dB
	1200 MHz		-0.45	_____	+0.45	dB
	1300 MHz		-0.45	_____	+0.45	dB
	1400 MHz		-0.45	_____	+0.45	dB
	1500 MHz		-0.45	_____	+0.45	dB
	1600 MHz		-0.45	_____	+0.45	dB
	1700 MHz		-0.45	_____	+0.45	dB
	1800 MHz		-0.45	_____	+0.45	dB
	1900 MHz		-0.45	_____	+0.45	dB
	2000 MHz		-0.45	_____	+0.45	dB

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
3	Frequency response	5.3.3				
	RF-Attenuation a_{FSE} = 40 dB 120 MHz (absolute error)		-0.2	_____	+0.2	dB
	f_{fresp}					
	1 MHz		-0.45	_____	+0.45	dB
	10 MHz		-0.45	_____	+0.45	dB
	50 MHz		-0.45	_____	+0.45	dB
	100 MHz		-0.45	_____	+0.45	dB
	200 MHz		-0.45	_____	+0.45	dB
	300 MHz		-0.45	_____	+0.45	dB
	400 MHz		-0.45	_____	+0.45	dB
	500 MHz		-0.45	_____	+0.45	dB
	600 MHz		-0.45	_____	+0.45	dB
	700 MHz		-0.45	_____	+0.45	dB
	800 MHz		-0.45	_____	+0.45	dB
	900 MHz		-0.45	_____	+0.45	dB
	1000 MHz		-0.45	_____	+0.45	dB
	1100 MHz		-0.45	_____	+0.45	dB
	1200 MHz		-0.45	_____	+0.45	dB
	1300 MHz		-0.45	_____	+0.45	dB
	1400 MHz		-0.45	_____	+0.45	dB
	1500 MHz		-0.45	_____	+0.45	dB
	1600 MHz		-0.45	_____	+0.45	dB
	1700 MHz		-0.45	_____	+0.45	dB
	1800 MHz		-0.45	_____	+0.45	dB
	1900 MHz		-0.45	_____	+0.45	dB
	2000 MHz		-0.45	_____	+0.45	dB
4	Display linearity	5.3.4				
	a_{ATT}					
	16 dB		-	Reference	-	-
	18 dB		-2.15	_____	-1.85	dB
	20 dB		-4.15	_____	-3.85	dB
	22 dB		-6.15	_____	-5.85	dB
	24 dB		-8.15	_____	-7.85	dB
	26 dB		-10.15	_____	-9.85	dB
	28 dB		-12.15	_____	-11.85	dB
	30 dB		-14.15	_____	-13.85	dB
	32 dB		-16.15	_____	-15.85	dB
	34 dB		-18.15	_____	-17.85	dB
	36 dB		-20.15	_____	-19.85	dB
	38 dB		-22.15	_____	-21.85	dB
	40 dB		-24.15	_____	-23.85	dB
	42 dB		-26.15	_____	-25.85	dB
	44 dB		-28.15	_____	-27.85	dB
	46 dB		-30.15	_____	-29.85	dB
	48 dB		-32.15	_____	-31.85	dB
	50 dB		-34.15	_____	-33.85	dB
	52 dB		-36.15	_____	-35.85	dB
	54 dB		-38.15	_____	-37.85	dB
	56 dB		-40.15	_____	-39.85	dB

Item No.	Characteristic	Test to section	Min. value	Actual value	Max. value	Unit
5	Attenuator	5.3.5				
	a_{ATT}					
	40		-40.1	_____	-39.9	dBm
	30		-30.1	_____	-29.9	dBm
	20		-20.1	_____	-19.9	dBm
	10		-10.1	_____	-9.9	dBm

Annex A - Interfaces

A.1 IEC Bus Interface

The standard spectrum analyzer is equipped with an optional IEC/IEEE Bus connector. An IEEE 488 interface connector is located on the rear panel of the FSE. An external controller for remote control of the spectrum analyzer can be connected via the IEEE 488 interface connector using a shielded cable.

A second, optional IEC Bus interface can be installed in the instrument and is, with an installed processor option, assigned to the MS-DOS processor. This interface can be controlled by standard software (R&S-Basic, QUICK-Basic, etc.) under MS-DOS as well as under WINDOWS (VISUAL BASIC, etc.) with the delivered driver software. The IEC Bus interface allows the remote control of the spectrum analyzer via an external connection to both IEC Bus interfaces and, in addition, the control of other instruments via the IEC Bus interface located on the rear panel (e.g., control of a complete measurement system).

The following section describes the first IEC Bus interface over which the spectrum analyzer can be remotely controlled. The characteristics of the PC2A/PC-AT controller interface depend upon the user-installed software running on the MS-DOS processor and is, therefore, not described here.

Interface Characteristics

- 8-bit parallel data transfer
- bidirectional data transfer
- three-line handshake
- high data transfer rate of max. 350 kbyte/s
- up to 15 instruments can be connected
- maximal length of the interconnecting cables 15 m (single connection, 2m)
- wired-OR connection if several instruments are connected in parallel.

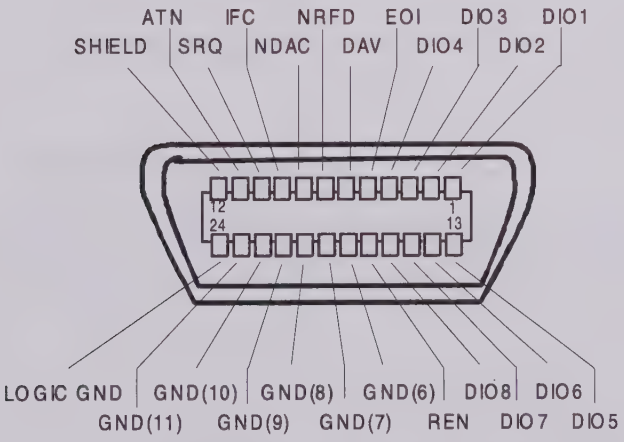


Fig. A-1 Pin assignment of IEC-Bus interface

Bus Lines

1. **Data bus with 8 lines DIO 1 to DIO 8.**
   The transmission is bit-parallel and byte-serial in the ASCII/ISO code. DIO1 is the least significant, DIO8 the most significant bit.

2. **Control bus with 5 lines.**
   IFC (Interface Clear),
   active low resets the interfaces of the devices connected to the default setting.

   ATN (Attention),
   active low signals the transmission of interface messages
   inactive high signals the transmission of device messages.

   SRQ (Service Request),
   active low enables a device connected to send a service request to the controller.

   REN (Remote Enable),
   active low permits the switch over to remote control.

   EOI (End or Identify),
   has two functions in connection with ATN:
   active low marks the end of data transmission when ATN=high
   active low triggers a parallel poll when ATN=low.

3. **Handshake bus with three lines.**
   DAV (Data Valid),
   active low signals a valid data byte on the data bus.

   NRFD (Not Ready For Data),
   active low signals that one of the devices connected is not ready for data transfer .

   NDAC (Not Data Accepted),
   active low as long as the device connected is accepting the data present on the data bus.

Interface Functions

Instruments which can be remote controlled via the IEC bus can be equipped with different interface functions. Table A-1 lists the interface functions appropriate for the instrument.

Table A-1 Interface functions

Control character	Interface function
SH1	Handshake source function (source handshake), full capability
AH1	Handshake sink function (acceptor handshake), full capability
L4	Listener function, full capability, deaddressed by MTA.
T6	Talker function, full capability, ability to respond to serial poll, deaddressed by MLA
SR1	Service request function (Service Request), full capability
PP1	Parallel poll function, full capability
RL1	Remote/Local switch over function, full capability
DC1	Reset function (Device Clear), full capability
DT1	Trigger function (Device Trigger), full capability
C12	Controller function, capability to send interface messages, to accept or relinquish the controller function

IEC Bus Messages

The messages transferred via the data lines of the IEC bus can be divided into two groups:

– **interface messages**
and
– **instrument messages.**

Interface Messages

Interface messages are transferred on the data lines of the IEC Bus when the "ATN" control line is active (LOW). They are used for communication between controller and instruments and can only be sent by the controller which currently has control of the IEC Bus.

Universal Commands

The universal commands are encoded 10 - 1F hex. They affect all instruments connected to the bus without addressing.

Table A-2 Universal Commands

Command	QuickBASIC command	Effect on the instrument
DCL (Device Clear)	IBCMD (controller%, CHR$(20))	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument settings.
IFC (Interface Clear)	IBSIC (controller%)	Resets the interfaces to the default setting.
LLO (Local Lockout)	IBCMD (controller%, CHR$(17))	The LOC/IEC ADDR key is disabled.
SPE (Serial Poll Enable)	IBCMD (controller%, CHR$(24))	Ready for serial poll.
SPD (Serial Poll Disable)	IBCMD (controller%, CHR$(25))	End of serial poll.
PPU (Parallel Poll Unconfigure)	IBCMD (controller%, CHR$(21))	End of the parallel-poll state.

Addressed Commands

The addressed commands are encoded 00 - 0F hex. They are only effective for instruments addressed as listeners.

Table A-3 Addressed Commands

Command	QuickBASIC command	Effect on the instrument
SDC (Selected Device Clear)	IBCLR (device%)	Aborts the processing of the commands just received and sets the command processing software to a defined initial state. Does not change the instrument setting.
GTL (Go to Local)	IBLOC (device%)	Transition to the "Local" state (manual control).
PPC (Parallel Poll Configure)	IBPPC (device%, data%)	Configure instrument for parallel poll. Additionally, the QuickBASIC command executes PPE/PPD.

Instrument Messages

Instrument messages are transferred on the data lines of the IEC bus when the "ATN" control line is not active. ASCII code is used.
Structure and syntax of the instrument messages are described in Chapter 3, Section 3.5. The commands are listed and explained in detail in Chapter 3, Section 3.6.

A.2 RS-232-C Interface

The standard FSE is equipped with two serial interfaces (RS-232-C). The RS-232-C interfaces are two independent, remote-control channels, both of which may be active at the same time. The programming and interrogation commands affect the same instrument hardware. The interfaces can be set up manually in the *SETUP-GENERAL SETUP* menu in the *COM PORT1/2* table or, via remote control, switched on/off with the command SYSTem:COMMunication:SERial1|2:STATe.

Each of the active RS-232-C interfaces is assigned to one of the 9-pin connectors located on the rear panel. Interface 1 is assigned to the connector COM1 and Interface 2 is assigned to the connector COM2.

Interface Characteristics

- Serial data transmission in asynchronous mode
- Bidirectional data transfer via two separate lines
- Transmission rate selectable from 110 to 19200 baud
- Logic '0' signal from+3 V to +15 V
- Logic '1' signal from -15 V to -3 V
- An external instrument (controller) can be connected.
- Software handshake (XON, XOFF)
- Hardware handshake

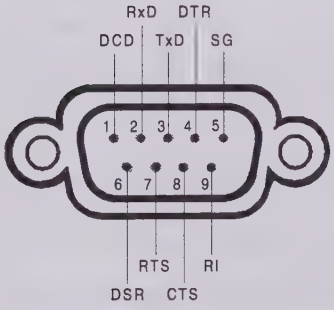


Fig. A-2 Pin assignment of the RS-232-C interface

Signal Lines

1. Data lines
The data transmission is bit-serial in ASCII code starting with the LSB. Two lines, **RxD** and **TxD** are necessary as the minimum requirement for transmission; however, no hardware handshake is possible. For handshaking, only the XON/XOFF software handshake protocol can be used .

RxD (Receive Data)
Input, LOW = logic '1', HIGH = logic '0'.
Data line, local terminal receives data from remote station.

TxD (Transmit Data)
Output, LOW = logic '1', HIGH = logic '0'.
Data line, local terminal transmits data to remote station.

2. Control lines

DCD (Data Carrier Detect),
Not used in FSE.
Input; active LOW.
Using this signal, the local terminal recognises that the modem of the remote station receives valid signals with sufficient level. DCD is used to disable the receiver in the local terminal and prevent reading of false data if the modem cannot interpret the signals of the remote station.

DTR (Data Terminal Ready),
Output, active LOW,
Indicates that the local terminal is ready to receive data.

DSR (Data Set Ready),
Input, active LOW,
Indicates that the remote station is ready to receive data.

RTS (Request To Send),
Output, active LOW.
Indicates that the local terminal wants to transmit data.

CTS (Clear To Send),
Input, active LOW.
Used to tell the local terminal that the remote station is ready to receive data.

RI (Ring Indicator),
Not used in FSE.
Input, active LOW.
Used by a modem to indicate that a remote station wants to establish a connection.

Transmission Parameters

To ensure error-free data transmission, the parameters of the instrument and the controller must have the same settings. The parameters are defined in the *SETUP-GENERAL SETUP* menu.

Transmission rate (baud rate)
the following transmission rates can be set in the analyzer: 110, 300, 600, 1200, 2400, 4800, 9600, 19200.

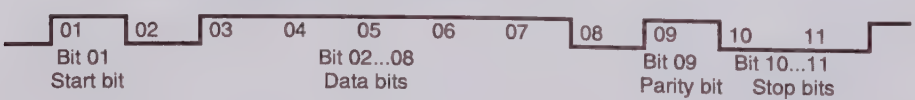
Data bits
Data transmission is in 7- or 8-bit ASCII code. The first bit transmitted is the LSB (least significant bit).

Start bit
Each data byte starts with a start bit. The falling edge of the start bit indicates the beginning of the data byte.

Parity bit
In order to detect errors, a parity bit may be transmitted. No parity, even parity or odd parity may be selected. In addition, the parity bit can be set to logic '0' or to logic '1'.

Stop bits
The transmission of a data byte is terminated by 1, 1,5 or 2 stop bits.

Example:
Transmission of character 'A' (41 hex) in 7-bit ASCII code, with even parity and 2 stop bits:



Interface Functions

For interface control, several strings are defined and control characters are reserved which are based upon IEC Bus control.

Table A-4 Control strings or control characters of the RS-232 interface

Control string or character	Function
"@REM"	Switch over to remote
"@LOC"	Switch over to local
"@SRQ"	Service Request SRQ (SRQ is sent by the instrument)
"@GET"	Group Execute Trigger (GET)
"@DCL"	Reset instrument (Device Clear DCL)
<Ctrl Q> 11 Hex	Enables character output
<Ctrl S> 13 Hex	Inhibits character output
0D Hex, 0A Hex	Terminator <CR>, <LF>

Handshake

Software handshake

In the software handshake mode of operation, the data transfer is controlled using the two control characters XON / XOFF.

The instrument uses the control character XON to indicate that it is ready to receive data. If the receive buffer is full, it sends the XOFF character via the interface to the controller. The controller then interrupts the data output until it receives another XON from the instrument. The controller indicates to the instrument that it is ready to receive data in the same way.

Cable required for software handshake

The connection of the instrument with a controller for software handshake is made by crossing the data lines. The following wiring diagram applies to a controller with a 9-pin or 25-pin configuration.

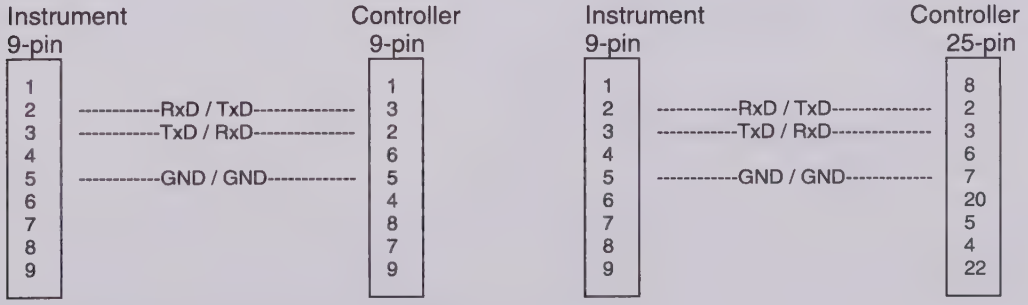


Fig. A-3 Wiring of the data lines for software handshake

Hardware handshake

For hardware handshake, the instrument indicates that it is ready to receive data via the lines DTR and RTS. A logic '0' on both lines means "ready" and a logic '1' means "not ready". The RTS line is always active (logic '0') as long as the serial interface is switched on. The DTR line thus controls the readiness of the instrument to receive data.

The readiness of the remote station to receive data is reported to the instrument via the CTS and DSR line. A logic '0' on both lines activates the data output and a logic '1' on both lines stops the data output of the instrument. The data output takes place via the TxD line.

Cable for hardware handshake

The connection of the instrument to a controller is made with a so-called zero modem cable. Here, the data, control and acknowledge lines must be crossed. The following wiring diagram applies to a controller with a 9-pin or 25-pin configuration.

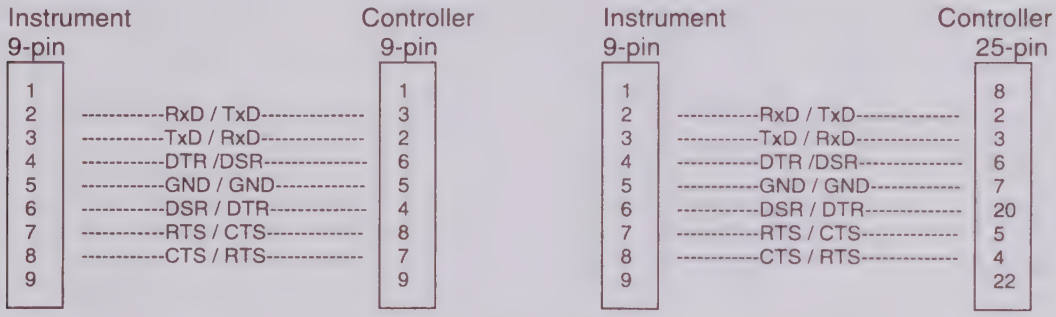


Fig. A-4 Wiring of the data, control and acknowledge lines for hardware handshake

A.3 User Interface (USER)

The user interface, located on the rear panel of the FSE, is a 25 pin Cannon connector which provides access to the two user ports (Port A and Port B). Each port is 8 bits wide (A0 - A7 and B0 -B7) and can be configured either as output or as input. The voltage levels are TTL levels (Low < 0,4 V, High > 2 V).

In addition, an internal +5 V power supply voltage is provided. The maximum load current is 100 mA.

The pin assignments for the USER connector can be seen in the following diagram:

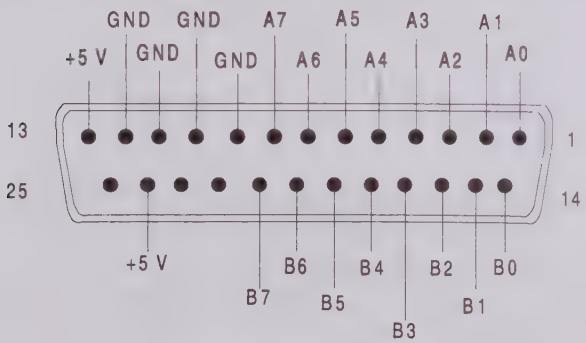
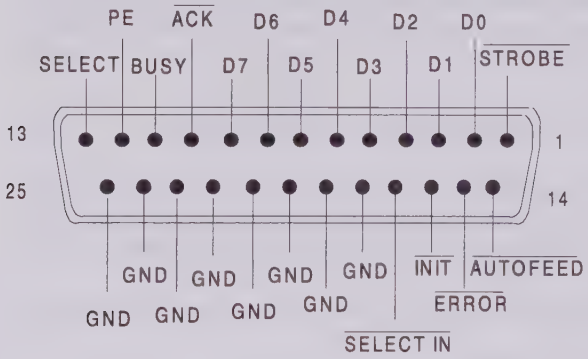


Fig. A-5 Pin assignments for the USER connector.

The configuration of the user ports takes place in the *SETUP* menu (SETUP key) in the *GENERAL SETUP* sub-menu.

A.4 Printer Interface (LPT)

The 25-pin LPT connector on the rear panel of the FSE is provided for the connection of a printer.. The LPT interface is compatible with the CENTRONICS printer interface.



Pin	Signal	Input (I) Output (O)	Description
1	STROBE	O	Pulse for transmitting a data byte, min. 1µs pulse width (active LOW)
2	D0	O	Data Line 0
3	D1	O	Data Line 1
4	D2	O	Data Line 2
5	D3	O	Data Line 3
6	D4	O	Data Line 4
7	D5	O	Data Line 5
8	D6	O	Data Line 6
9	D7	O	Data Line 7
10	ACK	I	Indicates that the printer is ready to receive the next byte. (active LOW)
11	BUSY	I	Signal is active when the printer cannot accept data. (active HIGH)
12	PE	I	Signal is active when the paper tray is empty. (active HIGH)
13	SELECT	I	Signal is active when the printer is selected. (active HIGH)
14	AUTOFEED	O	When signal is active, the printer automatically performs a linefeed after each line. (active LOW)
15	ERROR	I	This signal is high when the printer has no paper, is not selected or has an error status. (active LOW)
16	INIT	O	Initialise the printer. (active LOW)
17	SELECT IN	O	If signal is active, the codes DC1/DC3 are ignored by the printer. (active LOW).
18 - 25	GND		Ground connection.

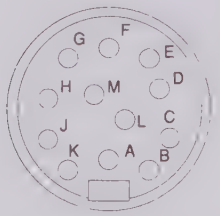
Fig. A-6 Pin assignments for the LPT connector.

A.5 Measurement Converters (PROBE CODE)

The PROBE CODE connector is used for supplying power to measurement converters and the providing the correct conversion factor coding to the FSE. Using it, the conversion factors for high-impedance probes, current converters and antennas can be encoded in 10dB steps. In addition, the quantity to be measured (field strength, current and voltage) is also passed to the FSE. Active converters can be supplied with ±10 V via the PROBE CODE connector. The following R&S accessories are deliverable with the applicable coding:

· Wide band dipole	20...80 MHz	HUF-Z2
· HF current converter	100 kHz..30 MHz	ESH2-Z1
· VHF current converter	20...300 MHz	ESV-Z1
· Current converter	20 Hz...100 MHz	EZ-17
· Preamplifier	20...1000 MHz	ESV-Z2.

The pins of the PROBE CODE connector are assigned as follows:



A ground
B +10 V, max. 50 mA
C µV/m (elec. field strength)
D µA
E 10 dB
F 20 dB
G 40 dB
H 80 dB
K -10 V, max. 50 mA
M factor sign inversion

Fig A.-7 Pin assignment for the 12-pin Tuchel connector.

A 12-pin connector is used for coding (manufacturer: Tuchel, R&S part number 0018.5362.00, Tuchel type number: T3635/2). The input pins for implementing the code are connected to ground.

Example: An antenna for measurement of the electromagnetic field strength has an antenna factor of 10 dB, i.e., a field strength of 10 dBµV/m produces a voltage at the RF input of 0 dBµV.

-> Pins C and E are connected to ground.

A.6 Probe Connector (PROBE POWER)

To allow the connection of probes, the FSE provides the PROBE POWER power connector. It delivers the power supply voltages +15 V and -12,6 V and ground.

The connector is also suited for powering the high-impedance probes from Hewlett Packard.

A.7 AF-Output (AF OUTPUT)

A miniature telephone jack can be used at the AF OUTPUT connector to connect an external loudspeaker, a headphone set or, e.g., a LF voltmeter. The internal resistance is 10 ohms and the output voltage can be controlled in the *MARKER DEMOD* menu. When a jack is plugged in, the internal loudspeaker is automatically turned off.

A.8 IF Output 21.4 MHz (21.4 MHz OUT)

The 21,4 MHz IF signal of the FSE is available at the IF 21.4 MHz OUT BNC connector. The bandwidth corresponds to the selected bandwidth for a resolution bandwidth between 2 kHz and 10 MHz. For a resolution bandwidth below 2 kHz, the bandwidth of the output is 5 kHz.

The signal level at the IF output is 0 dBm for signals which correspond to the selected reference level.

A.9 Video Output (VIDEO OUT)

The video output delivers the logarithmic envelope curve of the IF signal independent of the level scaling on the display screen (linear or logarithmic). The bandwidth of the video signal always corresponds to one-half of the IF bandwidth and is not limited by the video filter in the measurement path.

A.10 Reference Output/Input (EXT REF IN/OUT)

When the FSE is operated with the internal reference, the internal 10 MHz reference signal is also available at the REF IN/OUT connector and thus provides the capability of, e.g., synchronisation of external instruments to the FSE. The level is 1 V RMS at 50 ohms source impedance.

For operation with an external reference, this connector becomes an input connector. The internal reference oscillator is then synchronised to the reference applied to the connector. The reference frequency can be between 1 and 16 MHz in 1 MHz steps. The necessary level is > 0 dBm.

The selection of internal or external references takes place in the *SETUP* menu.

A.11 Sweep Output (SWEEP)

The SWEEP BNC connector delivers a saw-tooth voltage between - 5V and + 5 V which, for the frequency spectrum display, is proportional to the instantaneous frequency. The selected start frequency corresponds to a voltage of -5 V and the stop frequency corresponds to a voltage of +5 V.

A.12 External Trigger Input (EXT TRIGGER/GATE)

The EXT TRIG/GATE connector is used for controlling the measurement via an external signal.

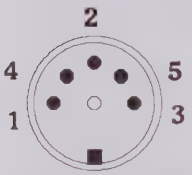
Trigger voltage range:: -5 V ... +5 V

A.13 Noise Source Control (NOISE SOURCE)

Using the NOISE SOURCE connector, an external noise source can be switched on/off, in order, e.g., to measure the noise figure of Units Under Test (UUTs). Usual noise sources require a +28 V signal to be turned on. At 0 V, they are turned off. These switching voltages are delivered by the connector.

A.14 External Keyboard (KEYBOARD)

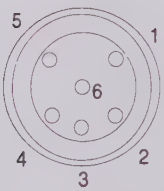
A 5-pin DIN connector is provided to allow connecting an external keyboard. Because of its low interference radiation, the PSA-Z1 keyboard is recommended (Order No. 1009.5001.31). However, any other multi-function keyboard may also be used.



Pin	Signal
1	Keyboard Clock
2	Data
3	Free
4	Ground
5	+5-V-Power Supply

Fig. A-8 Pin assignments of the KEYBOARD connector.

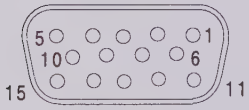
A.15 Mouse Connector (MOUSE)



Pin	Signal
1	MOUSECLK
2	MOUSEGND
3	MOUSEDATA
4	MOUSEVD5
5	NC
6	NC

Fig A-9 Pin assignments for the MOUSE connector.

A.16 Monitor Connector (MONITOR)



Pin	Signal
1	R
2	G
3	B
4	MID2
5	NC
6	R-GND
7	G-GND
8	B-GND
9	NC
10	GND
11	MID0
12	MID1
13	HSYNC
14	VSYNC
15	NC

Fig. A-10 Pin assignments of the MONITOR connector.

Annex B – List of Error Messages

The following list contains all error messages for errors occurring in the instrument. The meaning of negative error codes is defined in SCPI, positive error codes mark errors specific of the instrument.

The table contains the error code in the left-hand column. In the right-hand column the error text being entered into the error/event queue or being displayed is printed in bold face. Below the error text, there is an explanation as to the respective error.

B.1 SCPI-Specific Error Messages

No Error

Error code	Error text in the case of queue poll Error explanation
0	**No error** This message is output if the error queue does not contain any entries.

Command Error - Faulty command; sets bit 5 in the ESR register.

Error code	Error text in the case of queue poll Error explanation
-100	**Command Error** The command is faulty or invalid.
-101	**Invalid Character** The command contains an invalid sign. Example: A header contains an ampersand, "`SENSe&`".
-102	**Syntax error** The command is invalid. Example: The command contains block data the instrument does not accept.
-103	**Invalid separator** The command contains an impermissible sign instead of a separator. Example: A semicolon is missing after the command.
-104	**Data type error** The command contains an invalid value indication. Example: ON is indicated instead of a numeric value for frequency setting.
-105	**GET not allowed** A Group Execute Trigger (GET) is within a command line.
-108	**Parameter not allowed** The command contains too many parameters. Example: Command `SENSe:FREQuency:CENTer` permits only one frequency indication.

Continuation: Command Error

Error code	Error text in the case of queue poll Error explanation
-109	**Missing parameter** The command contains too few parameters. Example: The command `SENSe:FREQuency:CENTer` requires a frequency indication.
-110	**Command header error** The header of the command is faulty.
-111	**Header separator error** The header contains an impermissible separator. Example: the header is not followed by a "White Space", "`*ESE255`"
-112	**Program mnemonic too long** The header contains more than 12 characters.
-113	**Undefined header** The header is not defined for the instrument. Example: `*XYZ` is undefined for every instrument.
-114	**Header suffix out of range** The header contains an impermissible numeric suffix. Example: `SENSe3` does not exist in the instrument.
-120	**Numeric data error** The command contains a faulty numeric parameter.
-121	**Invalid character in number** A number contains an invalid character. Example: An "A" in a decimal number or a "9" in an octal number.
-123	**Exponent too large** The absolute value of the exponent is greater than 32000.
-124	**Too many digits** The number includes too many digits.
-128	**Numeric data not allowed** The command includes a number which is not allowed at this position. Example: The command `INPut:COUPling` requires indication of a text parameter.
-130	**Suffix error** The command contains a faulty suffix.
-131	**Invalid suffix** The suffix is invalid for this instrument. Example: nHz is not defined.
-134	**Suffix too long** The suffix contains more than 12 characters.
-138	**Suffix not allowed** A suffix is not allowed for this command or at this position of the command. Example: The command `*RCL` does not permit a suffix to be indicated.
-140	**Character data error** The command contains a faulty text parameter
-141	**Invalid character data** The text parameter either contains an invalid character or it is invalid for this command. Example: Write error with parameter indication;`INPut:COUPling XC.`

Continuation: Command Error

Error code	Error text in the case of queue poll Error explanation
-144	**Character data too long** The text parameter contains more than 12 characters.
-148	**Character data not allowed** The text parameter is not allowed for this command or at this position of the command. Example: The command `*RCL` requires a number to be indicated.
-150	**String data error** The command contains a faulty string.
-151	**Invalid string data** The command contains a faulty string. Example: An END message has been received prior to the terminating apostrophe.
-158	**String data not allowed** The command contains a valid string at a position which is not allowed. Example: A text parameter is set in quotation marks, `INPut:COUPling "DC"`
-160	**Block data error** The command contains faulty block data.
-161	**Invalid block data** The command contains faulty block data. Example: An END message was received prior to reception of the expected number of data.
-168	**Block data not allowed** The command contains valid block data at an impermissible position. Example: The command `*RCL` requires a number to be indicated.
-170	**Expression error** The command contains an invalid mathematical expression.
-171	**Invalid expression** The command contains an invalid mathematical expression. Example: The expression contains mismatching parentheses.
-178	**Expression data not allowed** The command contains a mathematical expression at an impermissible position.
-180	**Macro error** A faulty macro has been defined, or an error has occurred during execution of a macro.
-181	**Invalid outside macro definition** A macro parameter placeholder was encountered outside of a macro definition.
-183	**Invalid inside macro definition** A macro definition is syntactically wrong.
-184	**Macro parameter error** A command inside the macro definition has the wrong number or type of parameters.

Execution Error - Error on execution of a command; sets bit 4 in the ESR register

Error code	Error text in the case of queue poll Error explanation
-200	**Execution error** Error on execution of the command.
-201	**Invalid while in local** The command is not executable while the device is in local due to a hard local control. Example: The device receives a command which would change the rotary knob state, but the device is in local so the command can not be executed.
-202	**Settings lost due to rtl** A setting associated with hard local control was lost when the device changed to LOCS from REMS or to LWLS from RWLS.
-210	**Trigger error** Error on triggering the device.
-211	**Trigger ignored** The trigger (GET, *TRG or trigger signal) was ignored because of device timing considerations. Example: The device was not ready to respond.
-212	**Arm ignored** An arming signal was ignored by the device.
-213	**Init ignored** Measurement initialisation was ignored as another measurement was already in progress.
-214	**Trigger deadlock** The trigger source for the initiation of measurement is set to GET and subsequent measurement is received. The measurement cannot be started until a GET is received, but the GET would cause an interrupted-error)
-215	**Arm deadlock** The trigger source for the initiation of measurement is set to GET and subsequent measurement is received. The measurement cannot be started until a GET is received, but the GET would cause an interrupted-error.
-220	**Parameter error** The command contains a faulty or invalid parameter.
-221	**Settings conflict** There is a conflict between setting of parameter value and instrument state.
-222	**Data out of range** The parameter value lies out of the permissible range of the instrument.
-223	**Too much data** The command contains too many data. Example: The instrument does not have sufficient storage space.
-224	**Illegal parameter value** The parameter value is invalid. Example: The text parameter is invalid , `TRIGger:SWEep:SOURce TASTe`

Continuation: Execution Error

Error code	Error text in the case of queue poll Error explanation
-230	**Data corrupt or stale** The data are incomplete or invalid. Example: The instrument has aborted a measurement.
-231	**Data questionable** The measurement accuracy is suspect.
-240	**Hardware error** The command cannot be executed due to problems with the instrument hardware.
-241	**Hardware missing** Hardware is missing. Example: An option is not fitted.
-250	**Mass storage error** A mass storage error occured.
-251	**Missing mass storage** The mass storage is missing. Example: An option is not installed.
-252	**Missing media** The media is missing. Example: There is no floppy in the floppy disk drive.
-253	**Corrupt media** The media is corrupt. Example: The floppy is bad or has the wrong format.
-254	**Media full** The media is full. Example: There is no room on the floppy.
-255	**Directory full** The media directory is full.
-256	**File name not found** The file name cannot be found on the media.
-257	**File name error** The file name is wrong. Example: An attempt is made to copy to a duplicate file name.
-258	**Media protected** The media is protected. Example: The write-protect tab on the floppy is present.
-260	**Expression error** The expression contains an error.
-261	**Math error in expression** The expression contains a math error. Example: Divide-by-zero.

Continuation: Execution Error

Error code	Error text in the case of queue poll Error explanation
-270	**Macro error** Error on the execution of a macro.
-271	**Macro syntax error** The macro definition contains a syntax error.
-272	**Macro execution error** The macro definition contains an error.
-273	**illegal macro label** An illegal macro label is defined in the *DMC command. Example: The label is too long. The label is identical with the common command header or contains an invalid header syntax.
-274	**Macro parameter error** The macro definition improperly uses a macro parameter placeholder.
-275	**Macro definition too long** The macro definition is too long.
-276	**Macro recursion error** The command sequence defined by the macro is trapped in a program loop. Example: The event that would allow the loop to be exited does not occur.
-277	**Macro redefinition not allowed** The macro label defined in the *DMC command is already defined elsewhere.
-278	**Macro header not found** The macro label in the *GMC? query is not yet defined.
-280	**Program error** Error on the execution of a down-loaded program.
-281	**Cannot create program** The program cannot be created.
-282	**illegal program name** The name of the programm is illegal. Example: The name relates to a non-existing program.
-283	**illegal variable name** The inputted variable does not exist in the program.
-284	**Program currently running** The desired operation is not possible while the program is running. Example: A running program cannot be deleted.
-285	**Program syntax error** The down-loaded program contains a syntax error.
-286	**Program runtime error**

Device Specific Error; sets bit 3 in the ESR register

Error code	Error text in the case of queue poll Error explanation
-300	**Device-specific error** FSE-specific error not defined in greater detail.
-310	**System error** This error message suggests an error within the instrument. Please inform the R&S Service.
-311	**Memory error** Error in the instrument memory.
-312	**PUD memory lost** Loss of the protected user data stored using the *PUD command.
-313	**Calibration memory lost** Loss of the non-volatile calibration data stored using the *CAL? command.
-314	**Save/recall memory lost** Loss of the non-volatile data stored using the *SAV command.
-315	**Configuration memory lost** Loss of the non-volatile configuration data stored by the instrument.
-330	**Self-test failed** The selftest could not be executed.
-350	**Queue overflow** This error code is entered in the queue instead of the actual error code if the queue is full. It indicates that an error has occurred but not been accepted. The queue can accept 5 entries.

Query Error - Error in data request; sets bit 2 in the ESR register

Error code	Error text in the case of queue poll Error explanation
-400	**Query error** General error occurring when data are requested by a query.
-410	**Query INTERRUPTED** The query has been interrupted. Example: After a query, the instrument receives new data before the response has been sent completely.
-420	**Query UNTERMINATED** The query is incomplete. Example: The instrument is addressed as a talker and receives incomplete data.
-430	**Query DEADLOCKED** The query cannot be processed. Example: The input and output buffers are full, the instrument cannot continue operation.
-440	**Query UNTERMINATED after indefinite response** A query is in the same command line after a query which requests an indefinite response.

Annex C – Alphabetical List of Commands

Command	Parameter	Page
ABORt		3.6-7
CALCulate<1|2>:DELTamarker<1 to 4>:AOFF		3.6-9
CALCulate<1|2>:DELT<1 to 4>:FUNCtion:FIXed:RPOint:X	<numeric_value>	3.6-12
CALCulate<1|2>:DELT<1 to 4>:FUNCtion:FIXed:RPOint:Y		3.6-12
CALCulate<1|2>:DELT<1 to 4>:FUNCtion:FIXed:RPOint:Y:OFFSet	<numeric_value>	3.6-12
CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:FIXed[:STATe]	ON | OFF	3.6-12
CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise:RESult?		3.6-13
CALCulate<1|2>:DELTamarker<1 to 4>:FUNCtion:PNOise[:STATe]	ON | OFF	3.6-13
CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:APEak		3.6-10
CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:LEFT		3.6-11
CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:NEXT		3.6-10
CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum[:PEAK]		3.6-10
CALCulate<1|2>:DELTamarker<1 to 4>:MAXimum:RIGHt		3.6-10
CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:LEFT		3.6-11
CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:NEXT		3.6-11
CALCulate<1|2>:DELTamarker<1 to 4>:MINimum[:PEAK]		3.6-11
CALCulate<1|2>:DELTamarker<1 to 4>:MINimum:RIGHt		3.6-11
CALCulate<1|2>:DELTamarker<1 to 4>:MODE	ABSolute | RELative	3.6-9
CALCulate<1|2>:DELTamarker<1 to 4>:STEP:AUTO	ON | OFF	3.6-13
CALCulate<1|2>:DELTamarker<1 to 4>:STEP[:INCRement)]	<numeric value>	3.6-13
CALCulate<1|2>:DELTamarker<1 to 4>:TRACe	1 to 4	3.6-9
CALCulate<1|2>:DELTamarker<1 to 4>:X	0 to MAX (frequency | sweep time | symbols)	3.6-9
CALCulate<1|2>:DELTamarker<1 to 4>:X:RELative?		3.6-9
CALCulate<1|2>:DELTamarker<1 to 4>:Y?		3.6-10
CALCulate<1|2>:DELTamarker<1 to 4>[:STATe]	ON | OFF	3.6-8
CALCulate<1|2>:DLINe<1|2>	MIN to MAX (depending on current unit)	3.6-14
CALCulate<1|2>:DLINe<1|2>:STATe	ON | OFF	3.6-14
CALCulate<1|2>:FEED	'XTIM:DDEM:MEAS' | 'XTIM:DDEM:REF' | 'XTIM:DDEM:ERR:MPH' | 'XTIM:DDEM:ERR:VECT' | 'XTIM:DDEM:SYMB' | 'XTIM:AM' |'XTIM:FM' |'XTIM:PM' |'XTIM:AMSummary' |'XTIM:FMSummary' | 'XTIM:PMSummary' |'TCAP'	3.6-17
CALCulate<1|2>:FLINe<1|2>	0 GHz to f_{max}	3.6-15
CALCulate<1|2>:FLINe<1|2>:STATe	ON | OFF	3.6-15
CALCulate<1|2>:FORMat	MAGNitude | PHASe | UPHase | RIMag | FREQuency | IEYE | QEYE | TEYE | FEYE | COMP | CONS	3.6-18
CALCulate<1|2>:FSK:DEViation:REFerence	<numeric_value>	3.6-18
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel	0 to 100 dB, 0 to 100 dB	3.6-31

Command	Parameter	Page
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:RESult?		3.6-31
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ACHannel:STATe	ON | OFF	3.6-31
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>	0 to 100 DB, 0 to 100 DB	3.6-32
CALCulate<1|2>:LIMit<1 to 8>:ACPower:ALTernate<1|2>:STATe	ON | OFF	3.6-32
CALCulate<1|2>:LIMit<1 to 8>:ACPower[:STATe]	ON | OFF	3.6-31
CALCulate<1|2>:LIMit<1 to 8>:BURSt:POWer?		3.6-27
CALCulate<1|2>:LIMit<1 to 8>:BURSt:PTEMplate?		3.6-26
CALCulate<1|2>:LIMit<1 to 8>:CLEar[:IMMediate]		3.6-25
CALCulate<1|2>:LIMit<1 to 8>:COMMent	<string>	3.6-25
CALCulate<1|2>:LIMit<1 to 8>:CONTrol[:DATA]	<numeric_value>,<numeric_value>..	3.6-21
CALCulate<1|2>:LIMit<1 to 8>:CONTrol:DOMain	FREQuency | TIME	3.6-21
CALCulate<1|2>:LIMit<1 to 8>:CONTrol:MODE	RELative | ABSolute	3.6-21
CALCulate<1|2>:LIMit<1 to 8>:CONTrol:OFFset	<numeric_value>	3.6-21
CALCulate<1|2>:LIMit<1 to 8>:CONTrol:SHIFt	<numeric_value>	3.6-22
CALCulate<1|2>:LIMit<1 to 8>:CONTrol:UNIT[:TIME]	S | SYM	3.6-21
CALCulate<1|2>:LIMit<1 to 8>:COPY	1 to 8 | <name>	3.6-25
CALCulate<1|2>:LIMit<1 to 8>:DELete		3.6-26
CALCulate<1|2>:LIMit<1 to 8>:FAIL?		3.6-25
CALCulate<1|2>:LIMit<1 to 8>:LOWer[:DATA]	<numeric_value>	3.6-23
CALCulate<1|2>:LIMit<1 to 8>:LOWer:MARGin	<numeric_value>	3.6-24
CALCulate<1|2>:LIMit<1 to 8>:LOWer:MODE	RELative | ABSolute	3.6-24
CALCulate<1|2>:LIMit<1 to 8>:LOWer:OFFset	<numeric_value>	3.6-24
CALCulate<1|2>:LIMit<1 to 8>:LOWer:SHIFt	<numeric_value>	3.6-24
CALCulate<1|2>:LIMit<1 to 8>:LOWer:STATe	ON | OFF	3.6-24
CALCulate<1|2>:LIMit<1 to 8>:MARGin	0 to 100DB	3.6-30
CALCulate<1|2>:LIMit<1 to 8>:NAME	1 to 8 | <string>	3.6-26
CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:MODulation?	ARFCn | TXBand | RXBand | COMBined | DCSRx1800	3.6-27
CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:MODulation:EXCeptions?	ARFCn | TXBand | RXBand | COMBined | DCSRx1800	3.6-28
CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:MODulation:FAILs?	ARFCn | TXBand | RXBand | COMBined | DCSRx1800	3.6-28
CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:SWITching?	ARFCn | TXBand | RXBand | COMBined	3.6-29
CALCulate<1|2>:LIMit<1 to 8>:SPECtrum:SWITching:FAILs?	ARFCn | TXBand | RXBand | COMBined	3.6-29
CALCulate<1|2>:LIMit<1 to 8>:SPURious?	TXBand | OTXBand | RXBand | IDLeband	3.6-30
CALCulate<1|2>:LIMit<1 to 8>:SPURious:FAILs?	TXBand | OTXBand | RXBand | IDLeband	3.6-30
CALCulate<1|2>:LIMit<1 to 8>:STATe	ON | OFF	3.6-20
CALCulate<1|2>:LIMit<1 to 8>:UNIT	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ | DEG | RAD | S | HZ | PCT | UNITLESS	3.6-20
CALCulate<1|2>:LIMit<1 to 8>:UPPer:MARGin	<numeric_value>	3.6-23
CALCulate<1|2>:LIMit<1 to 8>:UPPer:MODE	RELative | ABSolute	3.6-23

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CALCulate<1|2>:LIMit<1 to 8>:UPPer:OFFset	<numeric_value>	3.6-22
CALCulate<1|2>:LIMit<1 to 8>:UPPer:SHIFt	<numeric_value>	3.6-23
CALCulate<1|2>:LIMit<1 to 8>:UPPer:STATe	ON | OFF	3.6-22
CALCulate<1|2>:LIMit<1 to 8>:UPPer[:DATA]	<numeric_value>,<numeric_value>..	3.6-22
CALCulate<1|2>:MARKer<1 to 4>:AOFF		3.6-35
CALCulate<1|2>:MARKer<1 to 4>:COUNt	ON | OFF	3.6-36
CALCulate<1|2>:MARKer<1 to 4>:COUNt:FREQuency?		3.6-36
CALCulate<1|2>:MARKer<1 to 4>:COUNt:RESolution	0.1 | 1 | 10 | 100 | 1000 | 10000 Hz	3.6-36
CALCulate<1|2>:MARKer<1 to 4>:COUPled[:STATe]	ON | OFF	3.6-36
CALCulate<1|2>:MARK<1 to 4>:FUNC:ADEM:AFRequency[:RES?]		3.6-45
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:AM[:RESult?]	PPEak | MPEak | MIDDle | RMS	3.6-44
CALCulate<1|2>:MARK<1 to 4>:FUNC:ADEMod:CARRier[:RESult?]		3.6-45
CALCulate<1|2>:MARK<1 to 4>:FUNC:ADEM:FERRor[:RESult?]		3.6-45
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:FM[:RESult?]	PPEak | MPEak | MIDDle | RMS | RDEV	3.6-44
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ADEMod:PM[:RESult?]	PPEak | MPEak | MIDDle | RMS	3.6-44
CALCulate<1|2>:MARKer<1 to 4>:FUNC:ADEMod:SINad:RESult?		3.6-45
CALCulate<1|2>:MARKer<1 to 4>:FUNC:ADEMod:SINad[:STATe]	ON | OFF	3.6-45
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CENTer:	ON | OFF	3.6-51
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:CSTep:	ON | OFF	3.6-51
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DDEMod:RESult?	MERM | MEPK | MEPS | PERM PEPK | PEPS | EVRM | EVPK | EVPS IQOF | IQIM IADR | FERR | RHO	3.6-46
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:HOLDoff	10ms to 1000s	3.6-42
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation:SELect	AM | FM	3.6-42
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:DEModulation[:STATe]	ON | OFF	3.6-42
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MSTep		3.6-52
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown	<numeric_value>	3.6-40
CALCulate<1|2>:MARKer<1 to 4>:FUNC:NDBDown:FREQuency?		3.6-41
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:RESult?		3.6-40
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NDBDown:STATe	ON | OFF	3.6-40
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe:RESult?		3.6-41
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:NOISe[:STATe]	ON | OFF	3.6-41
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:RESult?	ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0	3.6-46
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:POWer:SELect?	ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0	3.6-46
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:REFerence:	ON | OFF	3.6-52
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor	(60dB/3dB) | (60dB/6dB)	3.6-42
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor:FREQuency?		3.6-43
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor:RESult?		3.6-43
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SFACtor:STATe	ON | OFF	3.6-43
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CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:STRack[:STATe]	ON | OFF	3.6-43
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AOFF		3.6-51
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:AVERage	ON | OFF	3.6-51
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:MAX:RESult?		3.6-48
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:MAX[:STATe]	ON | OFF	3.6-47
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:MEAN:RESult?		3.6-50
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:MEAN[:STATe]	ON | OFF	3.6-50
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:MIDDle:RESult?		3.6-49
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:MIDDle[:STATe]	ON | OFF	3.6-49
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:MPEak:RESult?		3.6-49
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:MPEak[:STATe]	ON | OFF	3.6-48
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:SUMMary:PHOLd	ON | OFF	3.6-50
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:PPEak:RESult?		3.6-48
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:PPEak[:STATe]	ON | OFF	3.6-48
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:RMS:RESult?	ON | OFF	3.6-50
CALCulate<1|2>:MARKer<1 to 4>:FUNC:SUMMary:RMS[:STATe]	ON | OFF	3.6-49
CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:ZOOM	<numeric_value>	3.6-41
CALCulate<1|2>:MARKer<1 to 4>:LOEXclude	ON | OFF	3.6-37
CALCulate<1|2>:MARKer<1 to 4>:MAXimum:APEak		3.6-37
CALCulate<1|2>:MARKer<1 to 4>:MAXimum:LEFT		3.6-38
CALCulate<1|2>:MARKer<1 to 4>:MAXimum:NEXT		3.6-37
CALCulate<1|2>:MARKer<1 to 4>:MAXimum[:PEAK]		3.6-37
CALCulate<1|2>:MARKer<1 to 4>:MAXimum:RIGHt		3.6-38
CALCulate<1|2>:MARKer<1 to 4>:MINimum:LEFT		3.6-39
CALCulate<1|2>:MARKer<1 to 4>:MINimum:NEXT		3.6-38
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Command	Parameter	Page
[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel]	0 to 1000 MHz	3.6-155
[SENSe:]POWer:ACHannel:MODE	ABSolute | RELative	3.6-155
[SENSe:]POWer:ACHannel:PRESet	ACPower | CPOWer | OBANdwidth | OBWidth | CN | CN0	3.6-156
[SENSe:]POWer:ACHannel:REFerence:AUTO	ONCE	3.6-156
[SENSe:]POWer:ACHannel:SPACing[:UPPer]	0 to 1000 MHz	3.6-154
[SENSe:]POWer:BANDwidth|BWIDth	0 to 100 PCT	3.6-156
[SENSe:]ROSCillator:EXTernal:FREQuency	1MHz to 16 MHz	3.6-157
[SENSe:]ROSCillator[:INTernal]:TUNe	0 to 4095l8	3.6-157
[SENSe:]ROSCillator[:INTernal]:TUNe:SAVe		3.6-157
[SENSe:]ROSCillator:SOURce	INTernal | EXTernal	3.6-157
[SENSe:]SWEep:COUNt	0 to 32767	3.6-159
[SENSe:]SWEep:EGATe	ON | OFF	3.6-159
[SENSe:]SWEep:EGATe:HOLDoff	0 to 100s	3.6-160
[SENSe:]SWEep:EGATe:LENGth	0 to 100s	3.6-160
[SENSe:]SWEep:EGATe:LEVel	-5V to +5V	3.6-159
[SENSe:]SWEep:EGATe:POLarity	POSitive | NEGative	3.6-160
[SENSe:]SWEep:EGATe:SOURce	EXTernal | RFPower	3.6-160
[SENSe:]SWEep:EGATe:TYPE	LEVel | EDGE	3.6-159
[SENSe:]SWEep:GAP	ON | OFF	3.6-161
[SENSe:]SWEep:GAP:LENGth	0 to 100s	3.6-161
[SENSe:]SWEep:GAP:PRETrigger	0 to 100s	3.6-161
[SENSe:]SWEep:GAP:TRGTogap	0 to 100s	3.6-161
[SENSe:]SWEep:POINts	500 to 2000	3.6-161
[SENSe:]SWEep:TIME	5 ms to 1000 s	3.6-158
[SENSe:]SWEep:TIME:AUTO	ON | OFF	3.6-158
[SENSe:]TCAPture:LENGth	1024 | 2048 | 4096 | 8192 | 16384	3.6-144
[SENSe:]TV:PSOFfset	0 to 6.5 MHz	3.6-162
[SENSe:]TV[:STATe]	ON | OFF	3.6-162
SOURce:AM:STATe	ON | OFF	3.6-163
SOURce:DM:STATe	ON | OFF	3.6-163
SOURce:FREQuency:OFFSet	-200 MHz to 200 MHz	3.6-164
SOURce:POWer:ALC:SOURce	INTernal | EXTernal	3.6-164
SOURce:POWer[:LEVel][:IMMediate][:AMPLitude]	20dBm to 0dBm / Option FSE-B12: -90dBm to 0dBm	3.6-164
SOURce:POWer[:LEVel][:IMMediate]:OFFSet	-200 dB to +200 dB	3.6-165
STATus:OPERation:CONDition?		3.6-167
STATus:OPERation:ENABle	0 to 65535	3.6-167
STATus:OPERation[:EVENt?]		3.6-167
STATus:OPERation:NTRansition	0 to 65535	3.6-168
STATus:OPERation:PTRansition	0 to 65535	3.6-168

Command	Parameter	Page
STATus:PRESet		3.6-168
STATus:QUEStionable:ACPLimit:CONDition?		3.6-174
STATus:QUEStionable:ACPLimit:ENABle	0 to 65535	3.6-174
STATus:QUEStionable:ACPLimit[:EVENt]?		3.6-174
STATus:QUEStionable:ACPLimit:NTRansition	0 to 65535	3.6-175
STATus:QUEStionable:ACPLimit:PTRansition	0 to 65535	3.6-175
STATus:QUEStionable:CONDition?		3.6-169
STATus:QUEStionable:ENABle	0 to 65535	3.6-169
STATus:QUEStionable[:EVENt?]		3.6-168
STATus:QUEStionable:FREQuency:CONDition?		3.6-175
STATus:QUEStionable:FREQuency:ENABle	0 to 65535	3.6-175
STATus:QUEStionable:FREQuency[:EVENt]?		3.6-175
STATus:QUEStionable:FREQuency:NTRansition	0 to 65535	3.6-176
STATus:QUEStionable:FREQuency:PTRansition	0 to 65535	3.6-176
STATus:QUEStionable:LIMit:CONDition?		3.6-171
STATus:QUEStionable:LIMit:ENABle	0 to 65535	3.6-171
STATus:QUEStionable:LIMit[:EVENt]?		3.6-171
STATus:QUEStionable:LIMit:NTRansition	0 to 65535	3.6-172
STATus:QUEStionable:LIMit:PTRansition	0 to 65535	3.6-172
STATus:QUEStionable:LMARgin:CONDition?		3.6-172
STATus:QUEStionable:LMARgin:ENABle	0 to 65535	3.6-172
STATus:QUEStionable:LMARgin[:EVENt]?		3.6-172
STATus:QUEStionable:LMARgin:NTRansition	0 to 65535	3.6-173
STATus:QUEStionable:LMARgin:PTRansition	0 to 65535	3.6-173
STATus:QUEStionable:NTRansition	0 to 65535	3.6-169
STATus:QUEStionable:POWer:CONDition?		3.6-170
STATus:QUEStionable:POWer:ENABle	0 to 65535	3.6-170
STATus:QUEStionable:POWer[:EVENt]?		3.6-170
STATus:QUEStionable:POWer:NTRansition	0 to 65535	3.6-171
STATus:QUEStionable:POWer:PTRansition	0 to 65535	3.6-170
STATus:QUEStionable:PTRansition	0 to 65535	3.6-169
STATus:QUEStionable:SYNC:CONDition?		3.6-173
STATus:QUEStionable:SYNC:ENABle	0 to 65535	3.6-173
STATus:QUEStionable:SYNC[:EVENt]?		3.6-173
STATus:QUEStionable:SYNC:NTRansition	0 to 65535	3.6-174
STATus:QUEStionable:SYNC:PTRansition	0 to 65535	3.6-174
STATus:QUEue[:NEXT?]		3.6-176
SYSTem:COMMunicate:GPIB:RDEVice<1|2>:ADDRess	0 to 30	3.6-178
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess	0 to 30	3.6-177
SYSTem:COMMunicate:GPIB[:SELF]:RTERminator	LFEOI | EOI	3.6-178
SYSTem:COMMunicate:SERial<1|2>:CONTrol:DTR	IBFull | OFF	3.6-178

Command	Parameter	Page
SYSTem:COMMunicate:SERial<1|2>:CONTrol:RTS	IBFull | OFF	3.6-178
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BAUD	<numeric_value>	3.6-179
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:BITS	7 | 8	3.6-179
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PACE X	ON | NONE	3.6-180
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:PARity[:TYPE]	EVEN | ODD | NONE	3.6-179
SYSTem:COMMunicate:SERial<1|2>[:RECeive]:SBITs	1 | 2	3.6-180
SYSTem:DATE	1980 to 2099, 1 to 12, 1 to 31	3.6-180
SYSTem:DISPlay:UPDate	ON | OFF	3.6-180
SYSTem:ERRor?		3.6-181
SYSTem:PASSword[:CENable]	'password'	3.6-181
SYSTem:PRESet		3.6-181
SYSTem:SET	<block>	3.6-181
SYSTem:SPEaker:VOLume	0 to 1	3.6-182
SYSTem:TIME	0 to 23, 0 to 59, 0 to 59	3.6-182
SYSTem:UPDate	ON | OFF	3.6-180
SYSTem:VERSion?		3.6-182
TRACe:COPY	TRACE1 | TRACE2 | TRACE3 | TRACE4 , TRACE1 | TRACE2 | TRACE3 | TRACE4	3.6-183
TRACe[:DATA]	TRACE1 | TRACE2 | TRACE3 | TRACE4, <block>|<numeric_value>	3.6-183
TRIGger<1|2>[:SEQuence]:HOLDoff	0 to 100 s	3.6-185
TRIGger<1|2>[:SEQuence]:LEVel[:EXTernal]	–5.0 V to +5.0 V	3.6-185
TRIGger<1|2>[:SEQuence]:LEVel:VIDeo	0 to 100 PCT	3.6-185
TRIGger<1|2>[:SEQuence]:SLOPe	POSitive | NEGative	3.6-185
TRIGger<1|2>[:SEQuence]:SOURce	IMMediate | LINE | EXTernal | VIDeo | RFPower | TV | AF	3.6-184
TRIGger[:SEQuence]:SYNChronize:ADJust:FRAMe:AUTO	ONCE	3.6-187
TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT	0 to 100 s	3.6-187
TRIGger[:SEQuence]:SYNChronize:ADJust:SLOT:AUTO	ONCE	3.6-188
TRIGger[:SEQuence]:SYNChronize:SOURce	FRAMe | TSC	3.6-188
TRIGger<1|2>[:SEQuence]:VIDeo:FIELd:SELect	ALL | ODD | EVEN	3.6-186
TRIGger<1|2>[:SEQuence]:VIDeo:FORMat:LPFRame	525 | 625	3.6-186
TRIGger<1|2>[:SEQuence]:VIDeo:LINE:NUMBer	<numeric value>	3.6-186
TRIGger<1|2>[:SEQuence]:VIDeo:SSIGnal:POLarity	NEGative | POSitive	3.6-186
UNIT<1|2>:POWer	DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere V | W | DB | PCT | UNITLESS | DBUV_MHZ | DBMV_MHZ | DBUA_MHZ | DBUV_M | DBUA_M | DBUV_MMHZ | DBUA_MMHZ	3.6-189
UNIT<1|2>:PROBe	ON | OFF	3.6-189

Annex D – Programming Examples

The examples explain the programming of the instrument and can serve as a basis to solve more complex programming tasks.

QuickBASIC has been used as programming language. However, the programs can be translated into other languages.

D.1 Including IEC-Bus Library for QuickBasic

```
REM ----------- Include IEC-bus library for quickbasic ----------------
'$INCLUDE: 'c:\qbasic\qbdecl4.bas'
```

D.2 Initialization and Default Status

The IEC bus as well as the settings of the instrument are brought into a defined default status at the beginning of every program. Subroutines "InitController" and "InitDevice" are used to this effect.

D.2.1 Initiate Controller

```
REM ------------ Initiate controller -----------
REM InitController
iecaddress% = 20                          'IEC-bus address of the
                                          'instrument
CALL IBFIND("DEV1", analyzer%)            'Open port to the instrument
CALL IBPAD(analyzer%, iecaddress%)        'Inform controller on instrument
                                          'address
CALL IBTMO(analyzer%, 11)                 'Response time to 1 sec
REM ***************************************************************************
```

D.2.2 Initiate Instrument

The IEC-bus status registers and instrument settings of the analyzer are brought into the default status.

```
REM ------------ Initiate instrument --------------
REM InitDevice
CALL IBWRT(analyzer%, "*CLS")           'Reset status register
CALL IBWRT(analyzer%, "*RST")           'Reset instrument
REM***************************************************************************
```

D.3 Transmission of Instrument Setting Commands

Center frequency, span, and reference level of the analyzer are set in this example.

```
REM -------- Instrument setting commands -------------
CALL IBWRT(analyzer%, "FREQUENCY:CENTER 120MHz")    'Center frequency 120 MHz
CALL IBWRT(analyzer%, "FREQUENCY:SPAN 10MHZ")       'Span 10 MHz
CALL IBWRT(analyzer%, "DISPLAY:TRACE:Y:RLEVEL -10dBm")
                                                    'Reference level -10dBm
REM ************************************************************************
```

D.4 Switchover to Manual Control

```
REM -------- Switch instrument over to manual control -----------
CALL IBLOC(analyzer%)                          'Set instrument to Local state
REM ************************************************************************
```

D.5 Reading out Instrument Settings

The settings made in example 3 are read out here. The abbreviated commands are used.

```
REM --------- Reading out instrument settings ---------
CFfrequency$ = SPACE$(20)             'Provide text variables (20 characters)
CALL IBWRT(analyzer%, "FREQ:CENT?")   'Request center frequency
CALL IBRD(analyzer%, CFfrequency$)    'Read value

CFspan$ = SPACE$(20)                  'Provide text variables (20 characters)
CALL IBWRT(analyzer%, "FREQ:SPAN?")   'Request span
CALL IBRD(analyzer%, CFspan$)         'Read value

RLevel$ = SPACE$(20)                  'Provide text variables (20 characters)
CALL IBWRT(analyzer%, "DISP:TRAC:Y:RLEV?")
                                      'Request reference level
CALL IBRD(analyzer%, RLevel$)         'Read value

REM -------- Display values on the screen -----------
PRINT "Center frequency: "; CFfrequency$,
PRINT "Span:             "; CFspan$,
PRINT "Reference level:  "; RLevel$,
REM************************************************************************
```

D.6 Positioning a Marker and Displaying Values

```
REM -------- Examples of marker functions -----------
CALL IBWRT(analyzer%, "CALC:MARKER ON;MARKER:MAX")
                                 'Activate marker1 and start peak search
MKmark$ = SPACE$(30)             'Provide text variables (30 characters)
CALL IBWRT(analyzer%, "CALC:MARK:X?;Y?")     'Request frequency and level
CALL IBRD(analyzer%, MKmark$)                'Read value

REM -------- Display values on the screen -----------
PRINT "Center frequency / level "; MKmark$,
REM ************************************************************************
```

D.7 Command synchronization

The possibilities for synchronization implemented in the following example are described in Section 3.7.6, Command Order and Command Synchronization.

```
REM -------- Examples of command synchronization ---------
REM The command INITiate[:IMMediate] starts a single sweep if the command
REM INIT:CONT OFF was previously sent. It should be ensured that the next
REM command is only then executed when the entire sweep is complete.

CALL IBWRT(analyzer%, "INIT:CONT OFF")

REM -------- First possibility: Use of *WAI ---------
CALL IBWRT(analyzer%, "ABOR;INIT:IMM; *WAI")

REM -------- Second possibility: Use of *OPC? ---------
OpcOk$ = SPACE$(2)                  'Space for *OPC? - Provide response
CALL IBWRT(analyzer%, "ABOR;INIT:IMM; *OPC?")
REM -------- here the controller can service other instruments ---------
CALL IBRD(analyzer%, OpcOk$)        'Wait for "1" from *OPC?

REM -------- Third possibility: Use of *OPC ---------
REM In order to be able touse the service request function in conjugation
REM with a National Instruments GPIB driver, the setting "Disable
REM Auto Serial Poll" must be changed to "yes" by means of IBCONF!

CALL IBWRT(analyzer%, "*SRE 32")     'Permit service request for ESR
CALL IBWRT(analyzer%, "*ESE 1")      'Set event-enable bit for
                                     'operation-complete bit
ON PEN GOSUB OpcReady                'Initialization of the
                                     'service request routine
PEN ON
CALL IBWRT(analyzer%, "ABOR;INIT:IMM; *OPC")

REM Continue main program here
STOP                                 'End of program

OpcReady:
REM As soon as the sweep has ended, this subroutine is activated
REM Program suitable reaction to the OPC service request.
ON PEN GOSUB OpcReady                'Enable service request routine again
RETURN
REM ************************************************************************
```

D.8 Service Request

The service request routine requires an extended initialization of the instrument in which the respective bits of the transition and enable registers are set.
In order to use the service request function in conjugation with National Instruments GPIB driver, the setting "Disable Auto Serial Poll" must be changed to "yes" by means of IBCONF!

```
REM ---- Example of initialization of the SRQ in the case of errors  ------
CALL IBWRT(analyzer%, "*CLS")                    'Reset Status Reporting System
CALL IBWRT(analyzer%,"*SRE 168")                 'Permit service request for
                                                 'STAT:OPER,STAT:QUES and ESR
                                                 'register
CALL IBWRT(analyzer%,"*ESE 60")                  'Set event-enable bit for
                                                 'command, execution, device-
                                                 'dependent and query error
CALL IBWRT(analyzer%,"STAT:OPER:ENAB 32767")     'Set OPERation enable bit for
                                                 'all events
CALL IBWRT(analyzer%,"STAT:OPER:PTR 32767")      'Set appropriate OPERation
                                                 'Ptransition bits
CALL IBWRT(analyzer%,"STAT:QUES:ENAB 32767")     'Set questionable enable bits
                                                 'for all events
CALL IBWRT(analyzer%,"STAT:QUES:PTR 32767")      'Set appropriate questionable
                                                 'Ptransition bits
ON PEN GOSUB Srq                                 'Initialization of the service
                                                 'request routine
PEN ON
REM Continue main program here
STOP
```

A service request is then processed in the service request routine.
Note: the variables userN% and userM% must be pre-assigned usefully!

```
Srq:
REM ------------ Service request routine -----------
DO
   SRQFOUND% = 0
   FOR I% = userN% TO userM%                     'Poll all bus users
        ON ERROR GOTO nouser                     'No user existing
        CALL IBRSP(I%, STB%)                     'Serial poll, read status byte
        IF STB% > 0 THEN                         'This instrument has bits set
                                                 'in the STB
           SRQFOUND% = 1
           IF (STB% AND 16)  > 0 THEN GOSUB Outputqueue
           IF (STB% AND 4)   > 0 THEN GOSUB Failure
           IF (STB% AND 8)   > 0 THEN GOSUB Questionablestatus
           IF (STB% AND 128) > 0 THEN GOSUB Operationstatus
           IF (STB% AND 32)  > 0 THEN GOSUB Esrread
        END IF
nouser:
   NEXT I%
LOOP UNTIL SRQFOUND% = 0
ON ERROR GOTO error handling
ON PEN GOSUB Srq: RETURN                         'Enable SRQ routine again
                                                 'End of SRQ routine
```

Reading out the status event registers, the output buffer and the error/event queue is effected in subroutines.

```
REM -------- Subroutines for the individual STB bits ------
Outputqueue:                                    'Reading the output buffer
Message$ = SPACE$(100)                          'Make space for response
CALL IBRD(analyzer%, Message$)
PRINT "Message in output buffer :"; Message$
RETURN

Failure:                                        'Read error queue
ERROR$ = SPACE$(100)                            'Make space for error variable
CALL IBWRT(analyzer%, "SYSTEM:ERROR?")
CALL IBRD(analyzer%, ERROR$)
PRINT " Error text :"; ERROR$
RETURN


Questionablestatus:                         'Read questionable status register
Ques$ = SPACE$(20)                          'Preallocate blanks to text variable
CALL IBWRT(analyzer%, "STATus:QUEStionable:EVENt?")
CALL IBRD(analyzer%, Ques$)
PRINT "Questionable Status:"; Ques$
RETURN

Operationstatus:                            'Read operation status register
Oper$ = SPACE$(20)                          'Preallocate blanks to text variable
CALL IBWRT(analyzer%, "STATus:OPERation:EVENt?")
CALL IBRD(analyzer%, Oper$)
PRINT "Operation Status:"; Oper$
RETURN


Esrread:                                    'Read event status register
Esr$ = SPACE$(20)                           'Preallocate blanks to text variable
CALL IBWRT(analyzer%, "*ESR?")              'Read ESR
CALL IBRD(analyzer%, Esr$)
IF (VAL(Esr$) AND 1) > 0 THEN PRINT "Operation complete"
IF (VAL(Esr$) AND 4) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 8) > 0 THEN PRINT "Device dependent error"
IF (VAL(Esr$) AND 16) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 32) > 0 THEN GOTO Failure
IF (VAL(Esr$) AND 64) > 0 THEN PRINT "User request"
IF (VAL(Esr$) AND 128) > 0 THEN PRINT "Power on"
RETURN
REM ************************************************************************

REM ------------- Error routine ----------------
Error handling:
PRINT "ERROR                                'Output error message
STOP                                        'Stop software
```

Annex E - Emulations

E.1 Mouse Control of Display Elements

The FSE can be optionally equipped with a mouse (see Chapter 1 "Connecting a Mouse").

All display and control elements (enhancement labels, soft keys, function fields, display and limit lines) which can be displayed on the display screen can also be controlled by the mouse. Each soft key or key is assigned to a display element.

The following table lists the controllable display elements and the assigned keys

Display element for mouse control.		**Assigned soft key or key**
Display field for Soft Key 1 to Soft Key 10		Soft Key 1 to Soft Key 10
Display field for menu arrow: right/center/left		Key right/center/left supplementary menu
Enhancement labels	*	--
	PA	SETUP key
	PS	SETUP key
	UNS	COUPLING key
	LVL	REF key
	FRQ	CENTER key
	1-x	TRACE 1 key
	2-x	TRACE 2 key
	3-x	TRACE 3 key
	4-x	TRACE 4 key
	TRG	TRIGGER key
	DC	INPUT key
	75Ω	INPUT key
	MAC	USER key
Status display	UNCAL	CAL key
	OVLD	REF key
	ERR	INFO key
Display fields above the diagram		
	Ref. Level / Max	REF key
	Level	NORMAL key
	Marker	COUPLING key
	RBW	COUPLING key
	VBW	COUPLING key
	SWT	INPUT key
	RF Att	INPUT key
	Mixer	REF key
	Unit	
Display fields below the diagram		
	Start	START key
	Stop	STOP key
	Center	CENTER key
	Span	SPAN key
	Trigger	TRIGGER key
	/Div	--

E.2 Front Panel Keyboard Emulation

The FSE can be equipped with an optional external keyboard.(see Chapter 1 "Connecting an External Keyboard"). The following table shows the external keyboard key combinations through which the functions of the front panel keys can be emulated.

Note: – *The key combination <ALT><S-Abf> (German keyboard) or <ALT> <SYSREQ> (English keyboard) switches between the instrument display screen and the DOS display screen.(for an installed processor option FSE-B15).*
– *In instrument mode, the key combination <ALT> <F1> switches the keyboard between the US-American language and the language selected in the GENERAL SETUP* menu.

FSE front panel keys		Key assignments for the external keyboard
Soft keys:	SK1	F1
	SK2	F2
	SK3	F3
	SK4	F4
	SK5	F5
	SK6	F6
	SK7	F7
	SK8	F8
	SK9	F9
	SK10	F10
Menu select:	Menu left	CTRL ←
	Menu right	CTRL →
	Menu up	CTRL ↑
Cursor control:	Cursor left	←
	Cursor right	→
	Cursor up	↑
	Cursor down	↓
Roll-key:	Turn left	SHIFT ↑
	Turn right	SHIFT ↓
Numeric keys:	0	0
	1	1
	2	2
	3	3
	4	4
	5	5
	6	6
	7	7
	8	8
	9	9
Units keys:	GHz...	ALT-G
	MHz...	ALT-M
	kHz...	ALT-K
	Hz...	<ENTER>
Edit keys:	Clear	<ESC>
	Backspace	BACK
Misc. data entry keys:		
	Exponent "Exp"	ALT-E
	Sign "+/-"	-
	Decimal point"."	.
Hold key:	Hold	SHIFT-F1
User menu:	User	SHIFT-F2
System keys:	Preset	SHIFT-F4
	Cal	ALT-F12
	Display	ALT-F10
	Info	SHIFT-F5

FSE front panel keys		Key assignments for the external keyboard
Configuration key group:	Mode	ALT-F2
	Setup	SHIFT-F8
Hardcopy key group:	Start	SHIFT-F6
	Settings	SHIFT-F9
Status key group :	Local	SHIFT-F3
Frequency key group:	Start	CTRL-F7
	Stop	CTRL-F8
	Center	CTRL-F9
	Span	CTRL-F10
Level key group:	Reference	CTRL-F11
	Range	CTRL-F12
	Input	ALT-F11
	Cal	ALT-F12
Marker key group :	Normal	CTRL-F1
	Search	CTRL-F2
	Delta	CTRL-F3
	→ Mkr	CTRL-F4
Lines key group :	Display	CTRL-F5
	Limit	CTRL-F6
Traces key group :	1	ALT-1
	2	ALT-2
	3	ALT-3
	4	ALT-4
Sweep key group :	--	ALT-F3
	--	ALT-F4
	--	ALT-F5
	Coupl.Fcts	ALT-F6
	.	ALT-F7
	Sweep	ALT-F8
	Trigger	
Memory key group:	Config	SHIFT-F10
	Save	SHIFT-F11
	Recall	SHIFT-F12
Data entry key group :	Step	SHIFT-F7
Letters and special characters		A to Z (ext.) a to z (ext.) Special characters (ext.)
Edit key		Delete
Cursor control		Home End Page up Page down